

Drawing Out

by Dan Nauman

Drawings by Tom Latané

Lesson #17: Forging a square bar into a round bar.

Definition: Reducing the cross-section of a bar

Intent: The student will learn to take a bar with a square cross section, and forge it into a bar with a round cross section, maintaining a consistent diameter throughout the length of the bar.

Tools: Basic tools, 1/2" "V" tongs.

Material: 1/2" square x 6". (One half inch square x six inches.)

Step One

Heat 4" of the length of the bar to a bright yellow heat.

Note: Do not leave your tongs in the fire when heating the bar. Doing so could heat the tong jaws to a malleable temperature, and will cause the jaws to distort when pressure is applied by grasping the bar.

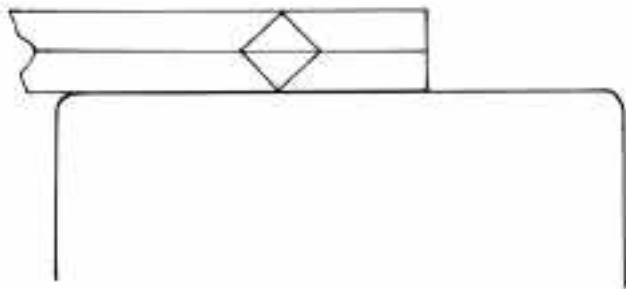
Your goal in this first step is to form the bar into an octagon.

Place the hot end of the bar, with one corner level on the anvil face. Make sure the opposing corner is directly above; not leaning to the right or to the left. (See drawing #1.)

Note: This initial position of the bar is important, as you will be making the square bar into a perfect octagon before forging it round. If the corners of the bar are not positioned correctly on this first step, the bar will twist, and you will get more of an oval cross section than a round cross section later in the process.

The end of the bar should be placed at the midpoint of the anvil face. Begin striking the end of the bar, with the hammer face parallel to the anvil's face. The facet you forge should be about 3/16" - 7/32".

Note: Do not chase the bar with the hammer. In other words, after each blow, feed the bar forward about half the width of your hammer's face. The hammer blows should remain concentrated in the same area of the anvil as your first blow. Since the position of the bar is moving, and the hammer direction is con-



1a. The bar on the diamond, held level with the anvil face, resting on one corner.

stant, you will find it easier to maintain control of the blows.

After each blow of the hammer, assess the impression to see if your hammer is maintaining a nice flat facet. If the previous blow shows a mark from the edge of your hammer, or a facet tendency to the right or to the left, adjust your hammer to make the correction. A proficient smith constantly assesses every blow, and adjusts the hammer head, the bar position, or both without breaking the rhythm of his/her blows.

Be attentive to maintain a constant material thickness along the length of the area you are forging.

Note: Right handed smiths will have a tendency to forge the facets with a lean to the right, and visa versa for left hand smiths. (See drawing #2.)

Continue forging down the length of the heated bar. Then rotate the bar 90 degrees (right or left) to forge down another corner the full heated length of the bar.

You have now forged four square corners of the square bar into facets.

Forging dynamics: The anvil is also flattening the opposing corner. Note that the width of that facet will be narrower, and will need to be dressed with the hammer.

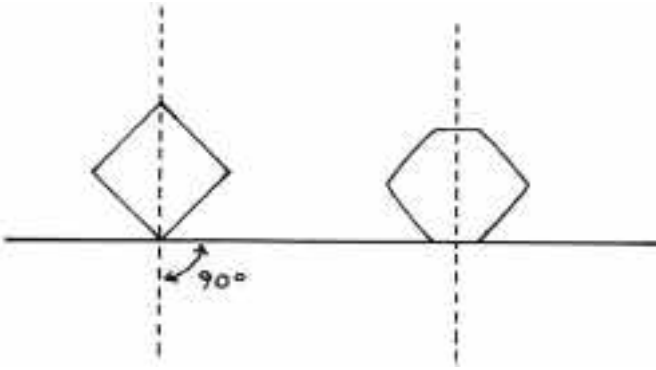
The metal itself is acting as a shock absorber. The more stock between the anvil and hammer, the less force applied by the anvil. Also, the original four facets will begin to slightly bulge. (See drawing #3.) This is caused by the force of the hammer blows, and since the bottom of the bar is supported by the anvil, the metal will seek the path of least resistance. These facets will need to be lightly dressed with the hammer to have eight uniform and flat facets.

These dynamics will be more apparent when working larger bar stock. The 1/2" bar that you are forging in this lesson may show little visible difference in facet width or bulging.

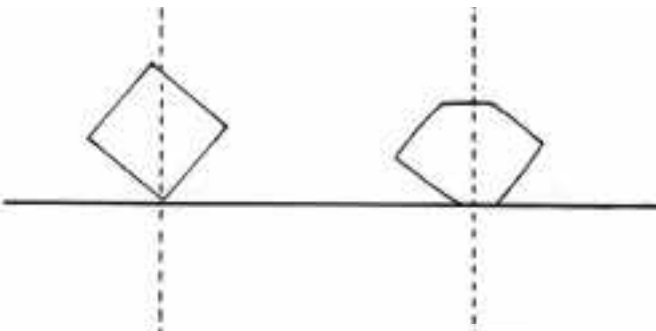
Rotate the bar 90 degrees in the same direction as you did earlier. This facet was forged by the anvil face, and will need to be lightly dressed, as will the next successive facet at 90 degrees.

As you are forging these facets, be aware of the width of the original four facets, as they are now becoming narrower, and have slightly bulged. The heat in the bar has diminished by this point. If the bar still has some dull orange color, begin to dress the all facets to a uniform width, with lighter blows. If the bar is more red than orange, reheat to a medium orange, and dress all the facets.

Note: Do not make the mistake of trying to dress the facets at a high heat. The facets of the bar are difficult to see when the bar is heated brighter than a medium orange. If the bar is forged, even though the facets cannot be readily seen, the result is a bar with mis-aligned facets, twisted facets, or corners that have been nicked.



1b. When the bar is held correctly, with the line between the top and bottom corners perpendicular to the anvil face, the resulting facets will be centered on that line.



1c. If the bar is not held with the top and bottom corners lined up perpendicular to the anvil face, the first few hammer blows will cause the bar to twist and the resulting facets will be skewed.

As the bar cools, and the facets and their respective corners are becoming uniform, lighter blows may be used to smooth the eight facets, and to sharpen the eight corners. This is often referred to as a “finishing heat.”

Step Two

Turn the bar around, and heat four inches to a bright yellow heat. You will be heating the bar partially into where you have already forged. You do this so that the area you wish to forge remains hot enough to forge the rest of the bar into an octagon.

Proceed to forge the end of the bar as in step one, and gradually work towards the middle of the bar until the facets blend into one another. Be careful to maintain the bar level on the anvil, and to keep your hammer blows parallel to the anvil face.

Note: It is at this point you will find out if you have a tendency to forge with your hammer head to the right or to the left. When you forge the facet on the opposing side of the bar, the facets should meet on the same plane. If there appears to be a twist at the point where your facets meet, you are probably not forging with the hammer head parallel to the anvil face, or you are not holding the square corners of the bar perpendicular to the anvil face. The correction is a delicate matter. With lighter blows, dress the errant facet to the correct plane by altering the

position of your hammer before proceeding to forge the succeeding facets.

If there is a constant twist throughout the bar, again this is a result of a right or left forging tendency. It could also indicate that you are holding the bar with the corners out of a vertical line. This twist is difficult to correct.

To correct a slight twist, reheat the twisted bar to a medium orange. Place a facet flat on the anvil face, with the middle of the bar at the near side of the anvil. (See drawing #4.) With light blows, strike the far end of the bar with the hammer face parallel to the anvil face. Proceed with your blows to the middle of the bar. Repeat this on all eight facets, or until the twist has been removed. Turn the bar around and repeat if necessary. The danger in this corrective action is that the bar’s cross-section may be reduced undersize, and could require upsetting to regain the proper thickness. A radically twisted bar (more than 1/8 revolution) more than likely will prove impossible to correct in this manner.

Of course, the bar could be heated to a dull orange, then placed in the vise and twisted to remove the twist. It is the aim of these lessons to teach the student to use the basic tools to increase hammer control, and less reliance on peripheral tools.

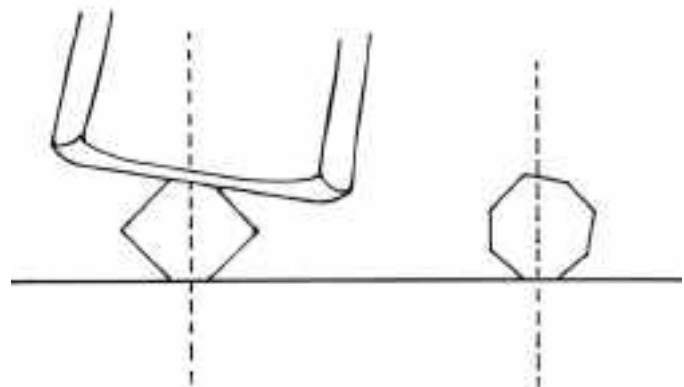
The best way to avoid the twist is to be careful and forge square to the anvil, and also to hold the steel in the proper position.

Step Three

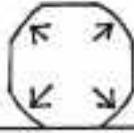
You should now have a uniform octagon. Check the bar thickness on all sides with an outside caliper. The facets should all be uniform in width, and the corners sharp.

The bar should also be straight. Check with a straight edge. The bar should also be 6 5/8" long, and the width across the facets between 17/32" to 9/16".

Forging Dynamics: Note that the cross section of the bar appears to have grown in size. The measurement across the diamond of the parent square bar is just under 11/16". What has happened is that the metal in the corners has been redistributed by forging, and in actuality, the cross section has been reduced, and the length of the bar has increased.



2. The result of the hammer blow tilted to one side.



3. The remnants of the four original faces of the bar are shown bulged by the displacement of the metal as the corners are forged.

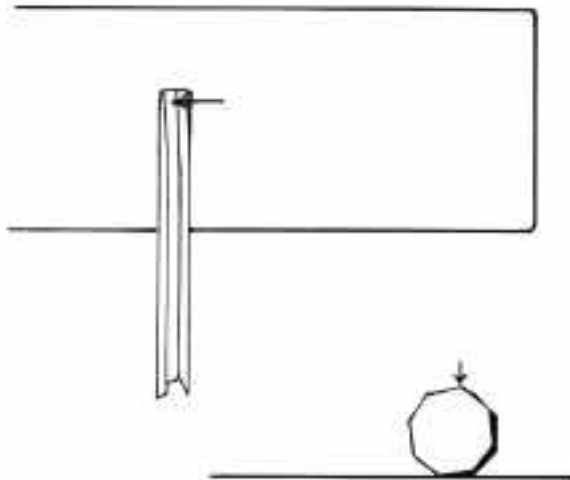
You may also find that the ends of the bar are thinner than in the middle. This is because there is less resistance at the ends of the bar, so the bar stretches easier at these points.

If your bar's ends are thinner, you will need to upset them and redress the facets to obtain a uniform cross section.

Step Four

You are now ready to forge the bar into a round cross section. The bar is longer as you have drawn out the bar to make the octagon. Heat four inches of the bar to a medium orange. Place the end of the bar in the middle of the anvil face with the bar lying level on one corner. With quick light blows, proceed to forge down the length of the hot bar as you did in Step One. Rapidly repeat on all corners. (See drawing #5)

When you have knocked all the corners down, place the end of the bar back at the center of the anvil, and begin to rock the bar back and forth 180 degrees. Then with light rapid blows, begin to refine the bar into a round cross section. Your goal in this step is to erase any sharp edges and facets. Aim the hammer at any sharp edges that remain on the bar. If you continually strike the facets, they will increase in width and the bar will not be forged



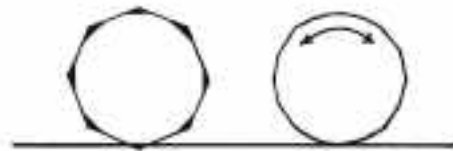
4. Correction of a slight twist may be accomplished by light flat hammer blows to the high corner at the end of the bar while the middle of the bar rests with a facet flat on the near side of the anvil.

to round. Work the bar about one width of the hammer's face until the bar is round (no facets or sharp edges.) Then feed the bar forward, and repeat the process, consecutively working only the width of the hammer's face at a time. Reheat to medium orange if necessary to complete this side of the bar. Rotate the bar to the radius that faced the anvil, and proceed with the rocking motion and continue refining to round.

Note: Working the bar in hammer face width segments makes it easier to maintain a uniform diameter.

You may work the bar to a black heat (finishing heat) to refine the bar, but do so only with very light rapid taps, and only if the major facets and edges have been removed.

Forging dynamics: The black heat is a brittle heat, and cannot



5. Sixteen rough facets are created by forging the eight corners of the octagon. Light rapid blows are then directed at the high spots while the bar is rolled back and forth. Continually rolling in one direction can cause a twist in the bar.

take the abuse of a heavy blow. Heavier blows at a black heat will result in cracking, splitting, or snapping.

Step 5

Turn the bar around, and repeat the process as in Step 4.

Targets

- The bar should be straight.
- The bar should have no facets or edges.
- The bar should have a uniform 7/32-9/16 diameter throughout its length.
- The bar should be 6 3/4 inches long, plus or minus 1/16".