Lesson 23 by Bob Fredell

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Introduction: The student should be able to correctly draw out a square bar before attempting this lesson. Drawing round to square is more difficult than drawing square to square because of the added difficulty to register an exact 90° rotation.

Intent: This lesson is designed to teach the student:
(1) How to accurately rotate the bar 90°;
(2) To develop hand-eye coordination in the rotation process;
(3) To gain a feel for the hit-and-rotate rhythm.

This will result in smooth and efficient drawing-out. This lesson uses round stock because it eliminates the initial guidance of the flat side of square stock on the anvil, thereby requiring the student to develop the three goals stated above.

To accomplish this goal, the student will forge a 5/8”x 24” round bar to square having 7/16” sides.

Material: Mild steel round bar, 5/8”x 24”, square bar 1/2”x about 24”.

Tools: Anvil, hammer, outside calipers, straightedge, tongs for 7/16” square.

Step One
This step is practice to get the feel of how much to rotate the wrist to turn the bar 90°. Hold the cold square bar flat on the anvil and rotate it 90° from one flat side to the next. Be aware of the amount of wrist rotation as the sides of the bar make contact with the anvil and observe the position of the sides of the bar in relation to the anvil. This process will aid the student in becoming confident developing the rhythm of making 90° rotations.

Step #2.
Heat 5” of the bar to a yellow heat and place it flat on the face of the anvil. It is always good to properly heat a slightly longer section than is to be forged. Starting at the end of the bar, strike a series of 4 or 5 overlapping blows to a length of 4”. Be sure to critically observe the result of each hammer blow as you are forging the bar. This will enable you to make corrections of incorrect rotation and incorrect angle of the hammer during the forging process.

Next, rotate 90°. Draw out the top-facing side of the 4” section as described above. The 4” section is now becoming square.

Then, rotate 90° in the same direction. The first side that was worked is now flat on the anvil. Draw out the 4” section as described above.

Again, rotate 90° in the same direction. Draw out the 4” as described above.

Note: The entire process will take several heats. Stop forging when the temperature drops to a dark orange heat even if the bar is not fully reduced, as the mild steel does not easily move with lower heat. Reheat and continue drawing out, as described above, until the sides are 7/16”. Crisp corners can be made by using a lower heat and lighter hammer blows when making the final adjustment to size. Initially you may need to use the calipers to measure. With practice your eye will be a fairly good judge of the correct size. It is important to establish well-defined sides and crisp 90° corners. Straighten the bar with light blows as necessary.

drawing 1.

drawing 2.

drawing 3.
This is not a contest with yourself to see how much work you can do in one heat. Focus on 90º rotation, rhythm of rotation and accuracy of blows. The hammer blows should be only as fast as you can control the hammer. Speed will come later.

Forging Dynamics: When forgining the bar, light blows and a low heat may result in the side of the bar being struck by the hammer to be drawn out more than the side facing the anvil, resulting in the hammer side being wider than the anvil side. The correction for this problem is to place the wide side (the side formerly struck by the hammer) down on the anvil and strike. Rotate the bar so the second wide side faces the anvil and strike. Continue to draw out as described above. It is necessary to work all four sides of the bar to achieve a uniform result.

Note: If the rotation is more or less than 90º, a parallelogram will result. Stop as soon as you see this developing and make corrections. Correct by hitting the corner of the long diagonal; then return to forging the flats of the bar. The sooner you catch this error the easier you may correct it. This is because as you approach your target size, you will not be able to eliminate the facets made by this correction without further reduction of the bar. This would then result in a cross-section smaller than desired.

Note: If the opposite faces of the forging are not parallel, it is because the hammer has not been landing parallel to the face of the anvil. Stop as soon as you see this happening and make corrections by making sure that the hammer face is parallel to the anvil.

Step #3.

Be sure the square portion is straight, square, and is the correct size before working the next round portion. Errors are always more easily corrected early on in the process.

Heat the next five inches and draw it out four more inches, as described in Step #2. The square portion will now grow to eight inches. Continue this process until you can no longer comfortably hold the round bar. Then, hold the square end with tongs and continue to draw out the entire length of the round bar as described above.

Note: As the square section becomes longer a twist may develop, caused by incorrect rotation and hammer angle. Should this occur, heat the twisted section to a red heat, place the end in the vise and reverse-twist with tongs or twisting wrench. Finish at a low heat on the anvil with light hammer blows.

Note: An easy way to see a twist is to place the bar horizontally in a vise. Then place a series of 3 to 5 flat bars (say 3/16” x 3/4” x 4”) on the bar, and sight down the length of the bar. The flat bars will dramatically show where the twist is.

The beginning blacksmith who is not familiar with strike-and-turn rhythm may need to make several, or even multiple tries of this lesson. Don’t be discouraged; focus on your rotation and hammer angle. Get the feel of the rhythm.
Targets:
1. The corners are 90° measured with a square.
2. The sides are 7/16” measured with calipers.
3. The corners are sharp with no visible facets.
4. The bar is straight as checked with a straightedge.
5. The surface smooth as checked with the straightedge.
6. An additional way to determine how closely you met the first five targets is to measure the final length of the now-square bar. The mathematically derived length of the bar is 38 1/2”. The closer you met the first five targets, the closer your bar will be to 38 1/2”. A slight loss of material results from scale.