

Bending

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Lesson #14- Forging a 90-degree corner

Definition: Altering the centerline of a bar.

Intent: To learn how to forge a sharp 90-degree corner while maintaining the parent stock dimensions throughout the bend, and have the resulting two legs measure to a predetermined length.

Tools: Anvil, 16- to 20-ounce cross-peen hammer, center punch, steel square.

Material: 1/2" square x 20" mild steel.

Step One

Note: When producing a bend of this nature you will lose some length, equal to half of the parent stock thickness, on both legs.

Also, when figuring how much metal will be needed for this bend in a project, remember that your measurements should be taken from the center (or mean line) of the bar on your layout, and not from the inside or outside corners.

Our target length for the short leg that will be formed is 3 3/4", and a target length of 15 3/4" for the long leg. With that in mind, measure 4" from the end of the bar, and mark with the center punch.

Step Two

Heat the bar to bright yellow, with the center punch mark centered in the heat.

Note: A short heat for this step will reduce the work in succeeding heats. The length of the heat when initially pulled from the fire will be too long. If this heat is not minimized, the resulting bend will require more effort to achieve your goal.

The bright yellow heat will give you some time to quench the bar. Using a dipping can, quench the bar (with water) down to 1/2" on either side of the center punch mark so that the heated area is confined to about 1 1/2"... ideal for this initial bend.

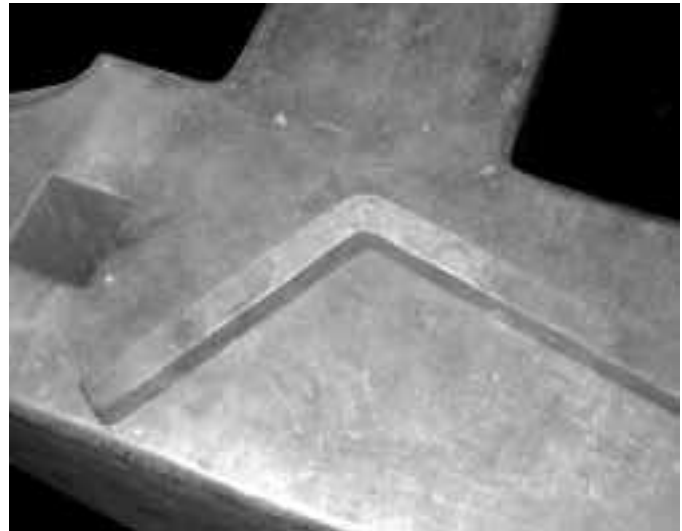
After you have minimized the heat, make sure the center punch mark is visible on the side of the bar, and position the bar so that the center punch mark is over a 1/8" radius on the far edge of the anvil. Proceed to bend the bar over the edge of the anvil by striking the end of the bar down. Bend the bar so that it is at about a 100-degree angle. (See photo #1)

Notes- Do not use a sharp corner of the anvil or the vise to make the initial bend. This can lead to galling on the inside corner which may lead to forming a shut (overlap) during subsequent steps. A shut in steel can form into a crack, weakening the piece. A shut in wrought iron will cause the leg to fall off.

Our goal is to teach you to make this bend with a minimum of tools. However, some smiths prefer to use the vise to perform a controlled, gentle bend in Step Two (avoiding a gall), and then

use it for a brace (or back-up) in succeeding steps. While this practice is not necessarily wrong, it must be noted that it takes precious time to place the piece in the vise. Also, the vise acts as a heat sink, robbing precious heat from the metal. These facts combined reduce your window of time to forge the corner.

Forging dynamics: From bending, the inside corner has now increased in cross-section from compression, and the outside corner has decreased in cross-section from stretching. This excess material on the inside corner can be moved to help replace the loss of material on the outside corner. The next step will help accomplish this task.



1. After the initial bend, the angle should be approximately 100 degrees, as shown here.



2. Position the hammer as shown when cross-peening the corner. Be mindful that you do not reduce the cross-section smaller than that of the parent stock.

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3. Stand at the heel of the anvil to forge this form.

Step Three

In the same heat from step two, lay the bar on its side on the anvil so both legs are resting on the face. Using the cross peen of the hammer, carefully forge down the excess material on the inside corner back down to 1/2". The peen should strike the bend, perpendicular to the 50-degree mean angle, so that the metal pushes to the outside corner. The legs themselves will help prevent the metal from flowing into the inside corner. (See photo #2)

Step Four

Heat the bend to bright yellow. Quench the bar to concentrate the heat to 1/2" on each side of the bend.



4. Vertical blow- note the position of the hammer and the short leg.

Note: Your stance at the anvil is important for this step. It will be easier for you to swing the hammer if you position yourself with your shoulders square to the heel of the anvil. (See photo #3)

Place the short leg ten degrees to the right of vertical (ten degrees to the left if you are left handed), with the end down on the face of the anvil. Strike the bar five or six times with hard blows. The blows should be focused so that the hammer face is in the same plane with the long leg, and slightly to the inside of the axis of the short leg. (See photo #4)

In the same heat, position the bar ten degrees to the left (or ten degrees to the right if you are left handed), and redirect your blows with the hammer's face in the same plane as the short leg, and just below the axis of the long leg. (See photo #5)



5. Horizontal blow-Note the position of the hammer and the short leg.

Proceed to strike the bar with seven to nine blows.

Alternate back and forth from the short leg to the long leg until the metal reaches a dull orange color. Maintain an angle of about 100 degrees. Count your blows as explained above.

Forging dynamics: The reason you strike more blows horizontally is that your hand is not as solid a brace as the anvil is for the vertical blows, thereby requiring more blows to accomplish the same task of moving material towards the corner.

Also, using a lighter hammer such as a 16- to 20-ounce hammer minimizes the possibility of forcing too much material to the inside corner of the bend (which could happen when using heavier hammers). The force delivered by a lighter hammer is expended on the surface of the bar. (See photo #6 of 1.8# hammer vs. 1# hammer.)

Step Five

Your work thus far has also increased the cross-section of the bar at the inside corner. As you did in step three, use the peen to

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6. Use a smaller hammer to do this operation. The hammer on the left is a one-pound hammer— a good hammer weight for the task. The hammer on the right is a 1.8 pound hammer which is too heavy for this form.

simultaneously reduce the cross-section, and push the excess material to the outside corner. Smooth with the face of the hammer. Be careful, as you do not want to reduce the corner to less than the parent stock size.

Step Six

Repeat steps four and five until the outside corner is visibly sharp (no greater than a 1/32" to 1/64" radius).

Note: If the legs begin to bend during any part of these procedures, straighten them at once or the energy from your blows will do more to continue bending the legs, rather than forging the corner.



7. When trueing the angle to 90 degrees, keep the short leg away from the anvil as shown here. Doing so will keep you from reducing the cross-section of the bar beneath the parent stock size.



8. Check your work with a square. Note that the legs are square, but there is a gap near the corner of the long leg, which should be corrected.

Step Seven

Heat the corner to bright yellow. Quench as in step four. Lay the long leg on top of the anvil. The short leg should point down off the anvil, with the inside corner away from the side of the anvil. With light blows striking horizontally towards the short leg, close the angle of the corner to 90 degrees (See photo #7). The legs can be straightened by lightly tapping on the anvil in any orientation that suits the task. Use the steel square to check your progress. (See photo #8.)

Note: Resist forging down on the bar on the corner of the anvil to achieve the 90-degree bend, or to straighten the legs. What you are trying to do at this point is to bend the bar to 90 degrees, not forge the bar to 90 degrees. Forging down on the legs to achieve the bend will reduce the cross-section of the legs near the corner.

Targets:

- The short leg is 3 3/4" long, and the long leg is 15 3/4" long, plus or minus 1/16".
- Both legs lie in the same plane. No twists or bends.
- The stock size remains 1/2" throughout the forging.
- The corner is 90 degrees, with a radius of 1/64" to 1/32" for an outside corner.
- The legs are straight, and do not slope down to the corner.
- The surface of the faces are smooth.
- With practice, the corner should be forged in five to six heats.
- There is no shut (overlap) on the inside corner.