

Forging Right-Angle Bends

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Charleston, South Carolina

Lesson #26A.

Part One: Forging Two-sided shoulders on the Near Edge of the Anvil

Intent: The student will learn to forge two-sided shoulders on the near edge of the anvil using only the forging hammer to control the location and dimension of the shoulders. This will be a first exercise laying the foundation for a more challenging two-shoulder exercise to follow.

Introduction: Matched two-sided shoulders as in photos 1 and 2 are features of much ironwork. Artifact photos appended show these shoulders on historic hardware collected in Charleston, SC. While such shoulders are effectively created using top and bottom fullers and a striker, or through the use of a spring die or guillotine tool, it is a skill worth pursuing with forging hammer alone. This pays dividends in increased hammer control, and for many projects it is a quick, efficient method. Most learners find that forging matched shoulders on the near edge of the anvil is easier than a similar pair using the far edge. Instruction begins with the easier challenge as shown in Photo 1.



Photo 1.



Photo 2.

Successful completion of these exercises both requires and develops good hand/eye coordination and overall hammer control. At the heart of such control is a relaxed and comfortable stance at the anvil. Smiths tend to adopt one or the other of two effective stances when forging these matched shoulders.

In the first instance, the smith approaches the anvil in a “normal” way with his or her shoulders roughly parallel to the anvil (Photo 3). The workpiece



Photo 3.

may be held slightly in front of the body. The shaping of a set of shoulders forged on the near edge of the anvil is mostly effected by the bottom edge of the hammer as indicated in Photo 4.



Photo 4.

The alternate stance positions the smith's shoulders roughly perpendicular to the front edge of the anvil (Photo 5). Here the workpiece is held on the anvil away from the smith's body but parallel to his or her own shoulders. When working at the near edge of the anvil, the right hand edge of the hammer (shown in Photo 6) matched with the edge of the anvil forms the shoulders.



Photo 5.

There are pluses and minuses to both stances, but the work required of the hammer is the same in each.

Tools Needed:

Basic forging tools only.

Note: This lesson, and the one that follows, are accomplished with your basic forging hammer and the rounded edges of your anvil. The article titled *Safety, Ergonomics, and Shop Layout* by Dan Nauman (*Hammers Blow*, Fall 2002) gives guidance in hammer selection and anvil set-up.



Photo 6.

The learner might also read *Drawing Down-Part One* (*Hammer's Blow*, Winter 2005) for discussion of the face of a general purpose, forging hammer. Although a round-faced hammer like a ball peen may be used in a pinch, a hammer with a square or octagonal face will be most useful. Closeup photos of the author's hammer accompany this lesson.

Material:

1/4" x 1" mild steel cut to approximately 24 inches in length (or any convenient hand-holding length).

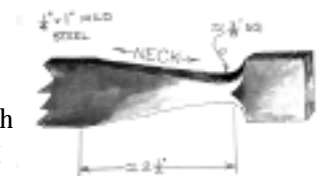


Figure 1.

Figure 1 shows the target shape. Unlike many discussions in this lesson series, target dimensions are less important here than control of the form. Consider for this lesson the accompanying dimensions are suggestions.

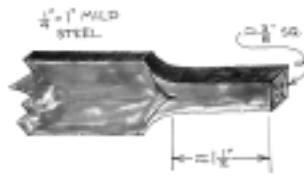


Figure 2.

More important than a particular measurement are forged shoulders opposite each other and in alignment. The shoulders should be sharp and distinct.

The extension created on the end of the bar is square in cross-section, centered along the axis of the bar and it can be allowed to grow thicker than the parent bar dimension of 1/4".

The almost inevitable slight pucker where the shoulders meet the extension should be minimal. The form must be straight and without twist.

Step #1

Cut a length of 1/4" x 1" bar approximately 24 inches long— or any length convenient to hand-hold. (A shorter bar held in well-fitting tongs is also acceptable.)

Heat two or three inches of the end of the bar to a yellow or lightly sparkling heat.

Step #2

Place the bar flat on the near-edge anvil so that a square of material lies on the anvil face as in Photo 7. Use a part of your anvil that has a well-rounded edge.



Photo 7.

Then, neither moving the bar forward nor back, rotate it so that it is on edge with the same material supported by the anvil. See Photo 8.

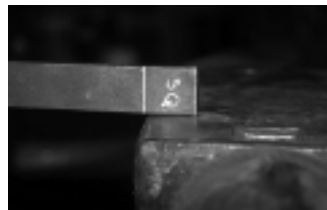


Photo 8.

Tip: A chalk or soapstone mark on the anvil one inch from the edge will also position the bar for this exercise. However, thinking of shape as opposed to dimension is a useful skill to develop. Here is an opportunity to judge ratio and proportion "at heat."

Keep the work-holding hand and arm relaxed and the bar horizontal. Only then will you create the sharpest set of shoulders. Any tendency to lower the holding hand so the anvil corner bites more into the work will result in an angled shoulder.

Step #3

With the target shape well in mind, the first hammer blows must be quick and hard to make full use of the available heat. Ideally, the hammer blows will exactly align with the near edge of the anvil and begin the needed shoulders. However, do not attempt to exactly match the hammer to the anvil edge with the first

blow. Rather, approach the target shape through *successive approximation*.

Start with a confident blow near the end of the bar. Take the second blow a little closer to the desired shoulder and the third a little closer still. Creep up on the desired match of the hammer to the anvil edge.

Photos 9, 10 and 11 show this series of hammer blows.

After three hammer blows (*maximum*), stop and rotate the bar so the other edge is uppermost. Feel for light contact between the shoulder you started and the rounded edge of the anvil.

Note: Even hammer blows that were significantly short of matching the anvil edge will begin to make a slight shoulder on the opposite side of the bar (Photo 12). Take advantage of this when repositioning the bar and as a target for your hammer blows.

Forging Dynamic: For every action there is an opposite and equal reaction. The force of the downward striking hammer causes the anvil in effect to strike up. But while a hammer blow's effect is concentrated in the area of contact between hammer face and workpiece, the anvil makes much broader contact. That is why a hammer blow that is not perfectly aligned with the edge of the anvil can still begin to create a shoulder on the underneath surface of the bar.

Repeat the series of hammer blows on this other vertical edge of the bar. All of this needs to happen very fast and very confidently.

Troubleshooting:

Early and continuous correction is key to success.

If the bar begins to become parallelogram in section, put the long cross-sectional axis vertical and forge it down. See *Controlled Hand Forging "Lesson One: Drawing Out"* by Peter Ross and Doug Wilson for guidance (*Hammer's Blow*, Winter 2003).



Photo 9.



Photo 10.



Photo 11.

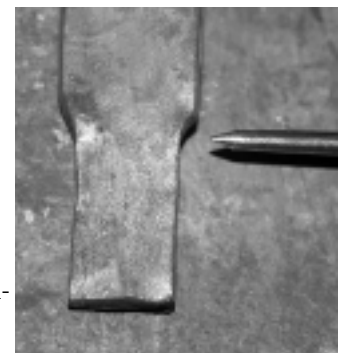


Photo 12.

If the bar begins to cup or collapse in one direction, this must be corrected by flattening before proceeding. Persisting with a bar that has started to cup in that way will only make the problem worse and increasingly hard to correct.



Photo 13.

Another related problem is a “pucker” or fold developing along the length of the bar. Photo 13 shows this clearly. While almost unavoidable to a small extent at the shoulder transition, if uncorrected it can become a lengthy cold shut.

If this pucker or cold shut plagues you, it is a good indication that you are working too cold and/or not hitting hard enough.

Forging Dynamic: When the bar is cool or the hammer blow light, the shaping force of the hammer is not transmitted into the middle of the bar. The shaping is, therefore, superficial and limited to the bar surface. The metal will always move in the path of least resistance. In the case of a bar on edge, as in this exercise, the path of least resistance is to the sides: the edges flare out leaving the shape of the middle of the bar relatively unaffected. The result will be a pucker or fold.

Step #4

High heat and hard hammer blows are so important to the success of this exercise, little is gained working below an orange heat. When the bar has reached an orange heat, get it back in the fire.

Likely a second or third heat will be necessary to complete this exercise. Start with the same yellow or lightly sparking heat. You should have the beginnings of shoulders on both edges of the bar. See Photo 14.



Photo 14.

The bottom shoulder will allow you to accurately position the bar on the edge of anvil; the upper shoulder will make a visual reference for your sequence of hammer blows. You may even be able to start closer to the shoulder and more confidently place the hammer face in relation to the anvil edge.

Again, hit hard and with intent, but take no more than three blows before rotating the bar to address the opposite edge.

Troubleshooting:

By now your shoulders will be definite enough that a new problem may develop: the extension may not be centered on the axis of the bar. This is usually the result of not working both of the edges equally.

This is corrected by placing the shallow shoulder down and against the edge of the anvil as in Photo 15. Keep the bar horizontal. Then, hit a blow on the upper shoulder to drive the extension back on center.



Photo 15.

Sometimes a misplaced blow or a bar not held touching the edge of the anvil will result in shoulders of equal depth but one forward of the other. This is a more challenging correction. See Photo 16.



Photo 16.

The short shoulder must be reset farther back to match the other.

First, blunt the sharp corner of the shoulder (Photo 17). This will help avoid a cold shut as the metal moves into the path of least resistance.



Photo 17.

Forging Dynamic: When struck with a hammer, the heated bar will move in the path of least resistance. A sharp shoulder that is struck vertically with a hammer will move forward and begin to fold over. Low heats and/or light hammer blows aggravate this effect. If the movement is not anticipated or not corrected, a cold shut may result.



Photo 18.

Next, place that shoulder down on the edge as in Photo 18. Hit one corrective blow. This will produce a shallow mark, the beginnings of a shoulder at an accurate location opposite its mate on the other edge of the bar.

Rotate the bar so the shallow shoulder mark is uppermost and work progressively into the newly positioned shoulder.

Targets:

Forge the shape including all corrections in three heats. Photo 1 and the drawing illustrate the target shape. Pay particular attention to the following points:

1. The extension must be centered visually on the centerline of the parent bar.
2. Any pucker at the base of the shoulders is not to extend more than about 1/2 inch up the extension.
3. Shoulders are of the same depth and positioned the same distance from the end of the extension.
4. The cross-section of extension is square—neither rectangular nor a parallelogram. Outside calipers can help determine this.
5. The form is visually straight and without twist.