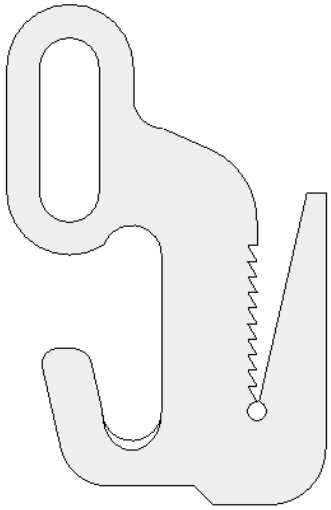
Figure 9 Rope Fastener – Measurement – Metal 8



Tools Needed

- Ruler
- Centerpunch
- Square
- Hammer
- Hacksaw
- Jeweler's Saw
- File
- Mini File
- Sandpaper
- Steel Wool

Machines Needed

- Drill Press

Materials Needed

- 80 mm long piece of 2" x 1/8" Flat Bar (Blue layout dye applied to one side)

Skills Developed

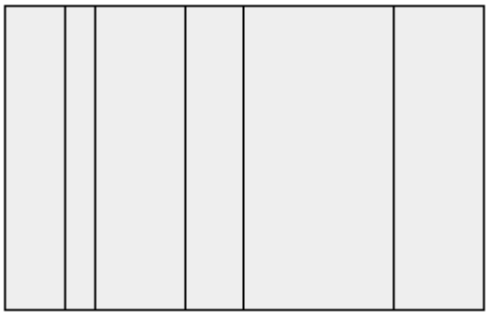
- Measurement and Layout
- Drill Press
- Jeweler's Saw

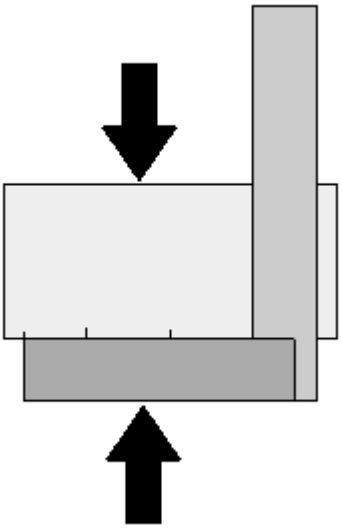
Measure and mark out the spots for the holes to be drilled

- Along one long edge, measure and mark the following points with the scribe.

10 mm
15 mm
30 mm
40 mm
65 mm

- Use the square the draw the lines across the entire piece of metal.

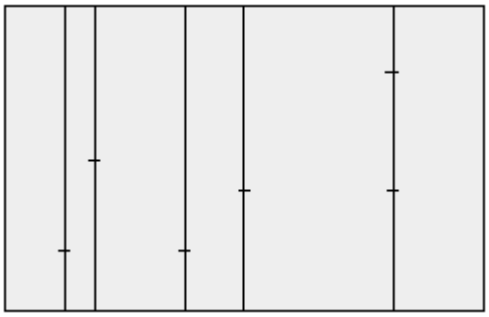




- The square will ensure the lines are perfectly straight across the piece of metal; do not use a ruler. Make sure you are holding the handle of the square tightly to the edge of your piece (squeezing where the arrows are in the image to the right), with the edge of the blade on the mark, use the center punch to scribe the line across the piece of metal. Do this for all the measurements along the edge of the piece of metal.

- Along the lines that you just drew, we need to mark off a second set of measurements. Do this by measuring along the line and putting a little dash across the line at the measurement listed below.

- Along the 10 mm line, mark it at 10 mm
- Along the 15 mm line, mark it at 25 mm
- Along the 30 mm line, mark it at 10 mm
- Along the 40 mm line, mark it at 20 mm
- Along the 65 mm line, mark it at 20 and at 40 mm

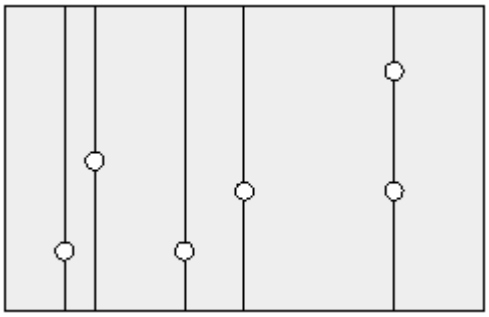


Centerpunch the spots

- Use a hammer and a centerpunch. Make sure the centerpunch is at the exact spot where the two measurements cross over each other. Swing hard and use just one strike. If you try and do several small hits with the hammer, the centerpunch may move and you won't have a clear spot to drill the hole.

- Repeat this for all six spots

Drill the holes out with a 1/8” drill bit



- Use a 1/8” drill bit on all 6 holes.

- Clamp your project in place tightly in the vice. Move the vice around and, by pulling on the handle, bring the drill bit down to line it up with one of the centerpunches.

- Hold the vice down with your left hand to make sure it doesn’t shift or lift up while drilling. Reach up and turn the drill on with your right hand.

- Pull the handle down to start drilling through the metal. Use constant, steady pressure. Pulling too lightly can cause the drill bit to heat up and become dull. Pulling too hard can cause the drill bit to jam or break. Once through, raise the drill back up and turn it off.

- Reposition the vice to line up the next hole and continue to do so for all six holes.

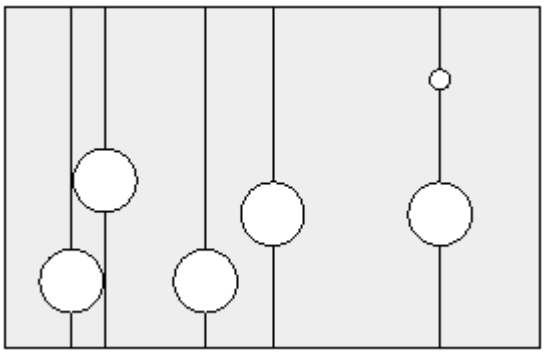
Drill the holes out with the 3/8” drill bit.

- 5 of the 6 holes need to be drilled out to a larger size, 3/8”.

- Clamp your project into the vice. Take your time to line up the center of the drill bit with the hole previously drilled in this spot. Take your time and look from multiple angles to make sure the large, flat spot at the center of the drill bit is seated in the hole.

- Use the hold down to clamp the vice down to the table to make sure it is held firmly in place. Double check that the drill bit is still aligned properly.

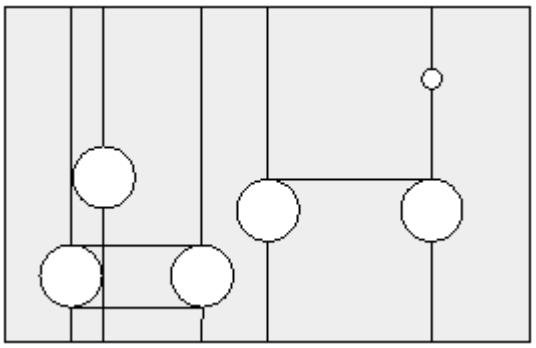
- When drilling through with the larger drill bit, do not go through all at once. After drilling through a bit of the material, back out of the cut to clear out the metal shavings. Do this two or three times as you’re drilling to stop the bit from jamming or grabbing the metal out of the vice.

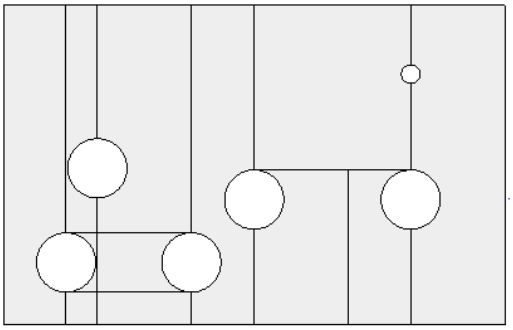


- Repeat this for the other 4 spots. Make sure you leave the final hole at 1/8”.

Layouts for the first cuts

- With a ruler, use a scribe to draw the lines highlighted in the image to the right. The holes need to line up with the outer edge of the holes that were just drilled.



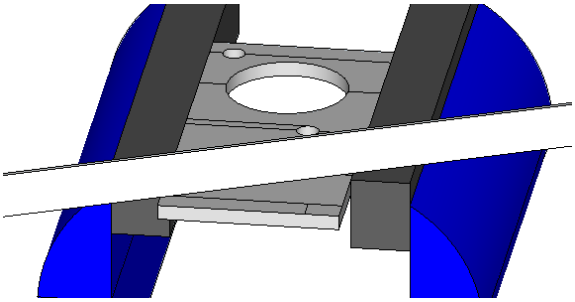


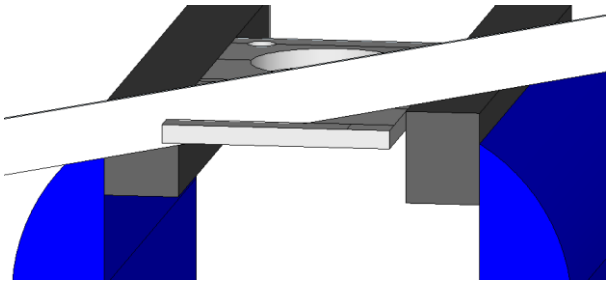
Along the bottom edge, measure and mark a spot 55 mm from the left. Use the square to draw the line up to the line you just scribed between the two holes.

Cut the first edges with a hacksaw

- Start by cutting the 25 mm line you just scribed.

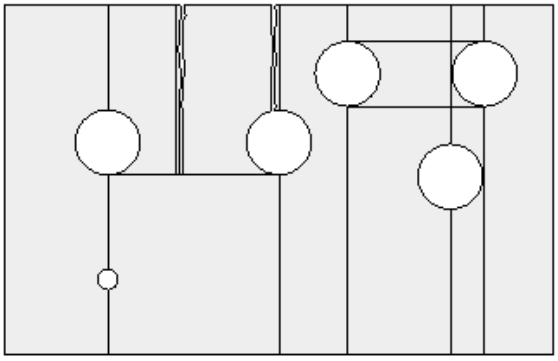
- Lay your project flat in the vice to start the cut. This will give you a better chance of keeping the cuts aligned properly and not crooked. Start the cuts with the saw on a slight angle to start cutting the front edge. Keep checking the make sure that the sign is lined up with the line that we drew. Once the cut is started, it is very difficult to change the angle it's on. The beginning is very important.





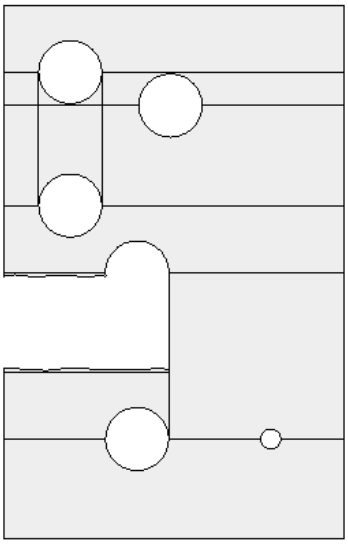
- Once there is a noticeable groove cut into the metal, move to the next spot. We also need to cut into the circle close to the center of the piece of metal. See the diagram to the left for the two spots we should be cutting at this stage.

- After you have grooves started, flip the piece so it is vertical in the vice. Continue all the cuts down to where they stop.



First cut with the Jeweler's Saw

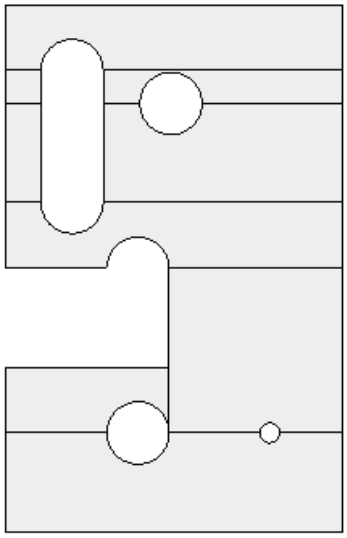
- Start by placing a blade into one of the jeweler's saw frames. Clamp the saw into your vice. Loosen the thumb screw on the upper blade clamp, the lower clade clamp and the handle; also loosen the tensioning wingnut. Take your blade and, with the teeth point up and angled towards the handle, clamp it in place in the lower blade clamp attached to the handle. Adjust the handle back and forth until the other end reaches the upper blade clamp and tighten it up to secure the blade. Pull the handle as far down the frame as possible to put tension on the blade and, while holding the handle in place, tighten the frame thumb screw. Put the final tension on the blade by tightening the tension wingnut at the end of the frame. If the blade still wiggles, re-tension it. Loosen the wingnut several turns, loosen the frame thumbscrew, pull the handle tight, and then retighten both screws.



- Clamp your piece in the vice vertical. Thread the jeweler's saw through one of your previous cuts then turn the saw and start cutting down. Follow the line that was scribed along the top edge of the circles (See image to the right).

- If the blade breaks, take out the broken pieces and put a new blade in place.

Inside cut with the Jeweler's Saw

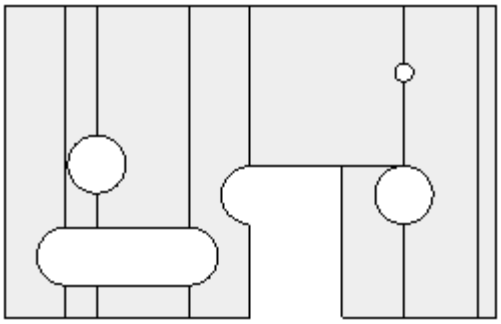


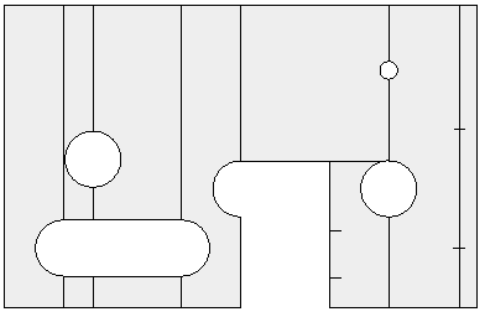
- Unwind the tension wingnut on the end of the saw, then unscrew the upper thumb screw to unclamp the end of the blade. Thread the blade through one of the holes in the corner of the project, where the scribed lines are connecting the edges of the circle. With the blade through the hole, reclamp the end of the blade with the upper thumb screw. Re-apply tension to the blade with the wingut.

- Cut down both lines scribed between the circles to remove the material between them.

Layout for the lower section

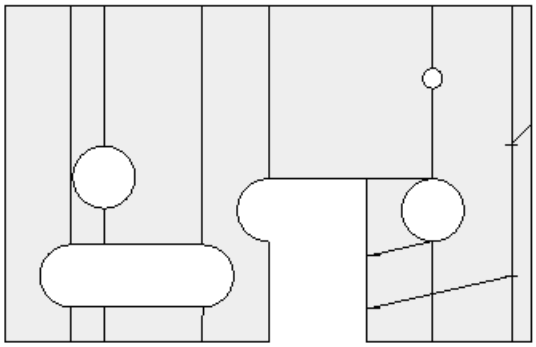
- Along the bottom edge, measure and mark a spot 77 mm from the left. Use a square to draw the line across the project.





- Along that line, measure and mark 10 mm and 30 mm. Along the line we had previously cut along with the hacksaw, measure and mark 5 mm and 15 mm.

- Using a ruler, scribe a line connecting the first point along the 77 mm line with the first point along the cut line. Scribe a second line connecting the second point along the cut line with the edge of the circle. Scribe a third short line on a slight angle at the second point along the 77 mm line.

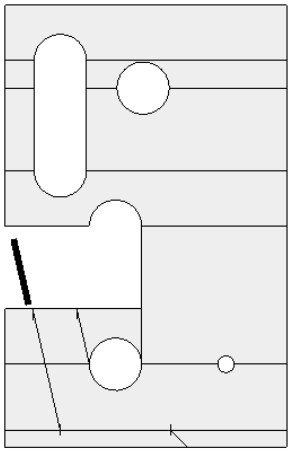


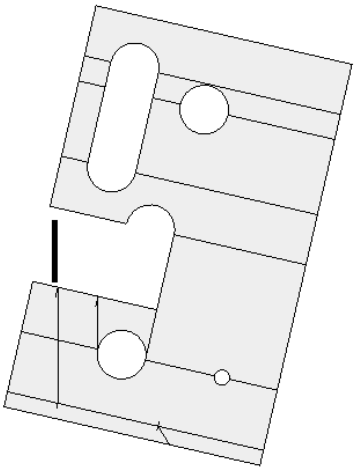
Cutting the lower section

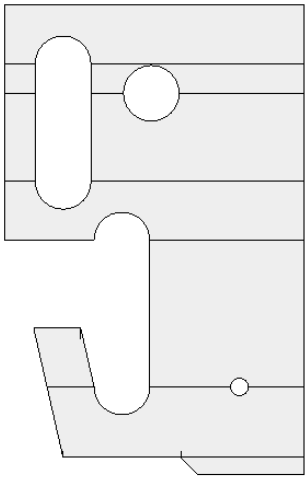
- Cut along the three angled lines and along the 77 mm line up until the angled line.

- When cutting on an angle, don't hold the saw on an angle. Instead we want to clamp our project on an angle so that our saw remains straight up and down.

WRONG **RIGHT**

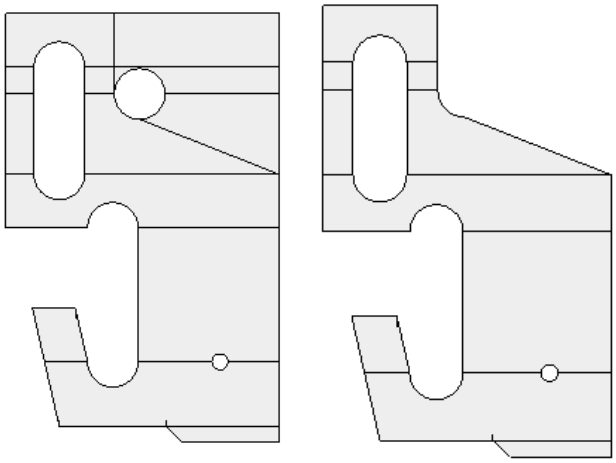






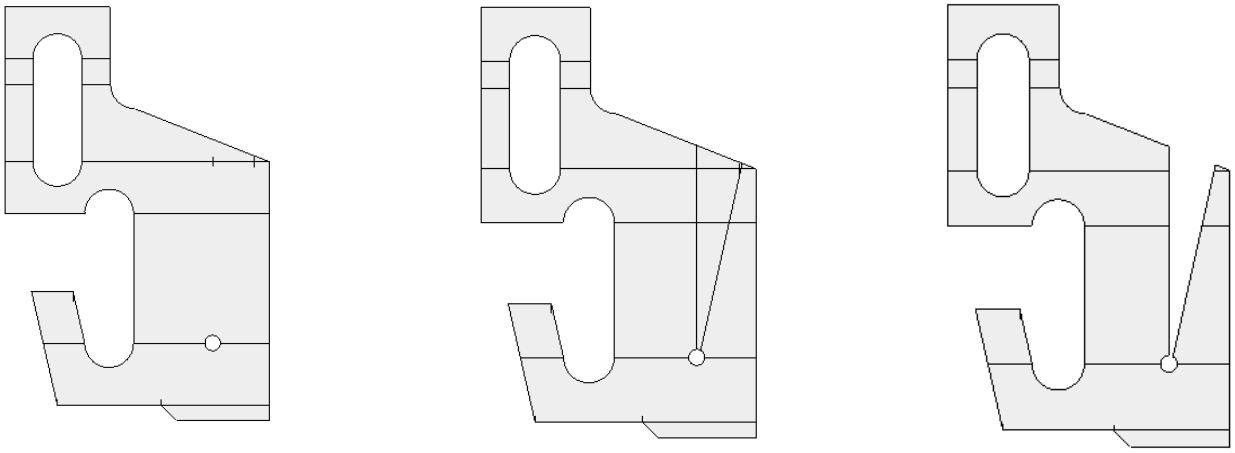
Layout and cutting the upper section

- You will have one 3/8” hole remaining that has not been modified, cut into, etc. Scribe a line straight from the edge of the hole to the edge of the material. Scribe a line from the other edge of the circle to the end of the 30 mm line. See the image to the right.



- Cut along these two lines with the hacksaw. Remember to angle the piece of metal when cutting and not the hacksaw.

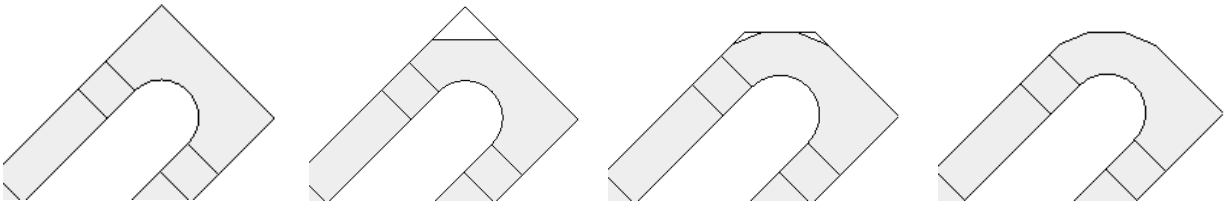
- Along the 30 mm line, measure and mark a spot at 40 mm and 48 mm. Using a ruler, scribe a line connecting these two points to the center of the 1/8” hole. Cut along these two lines with the hacksaw.



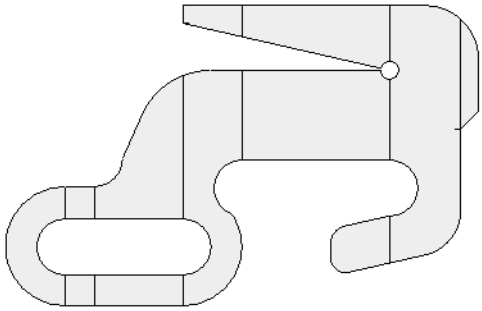
Filing to shape

- We now want to file all corners to shape. Make sure that wherever you are filing is clamped in tight and close to the surface of the vice to reduce vibrations and noise.

- Start by filing the corners to take the high points down. While moving the file back and forth, slowly angle the file from side to side to create a smooth curve from one edge to the next (See the images below as a guide).



- Continue filing all corners until they are around and smooth.

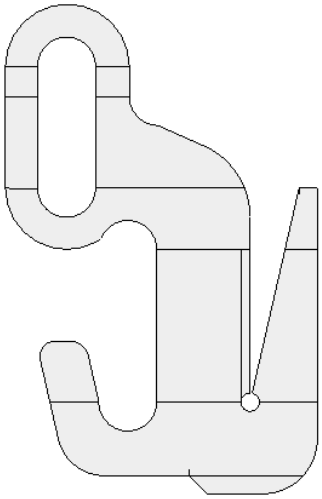


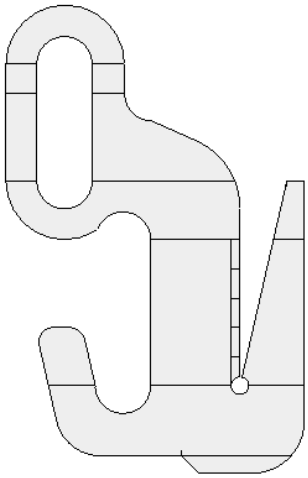
- Also make sure to file any edges that were cut with the saws, both hacksaw and jewelry saw, are filed smooth and all cut marks are removed. We also want to make sure that we have filed all the edges down to the scribed lines that were drawn as guides for the cuts.

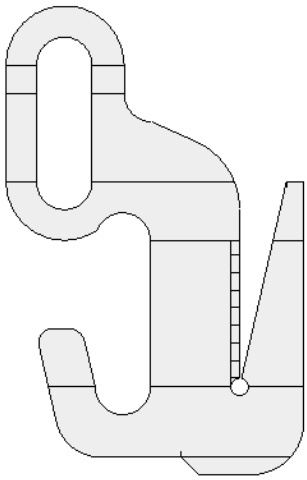
- If you cannot fit a full sized file into an area that needs to be filed, use one of the miniature files.

Layout and filing the teeth

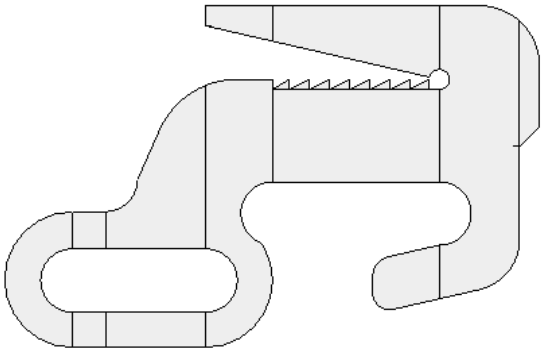
- Using a ruler, scribe a line from the edge of the 1/8” hole straight to the 40 mm line. Along this line, measure and mark every 5 mm. Make sure the mark goes between the edge and the line you just scribed. Then go and split each of these sections in have by measuring and marking 2.5 mm between each spot.







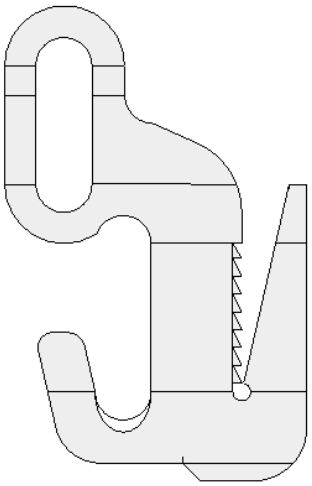
- Use a miniature square file to then file angles on each section measured and marked. Make sure the angled sides are facing the opening and the flat edges are facing the hole.



Deburr the edges.

- Hold your piece on the back of the vice. Start with the file held low, close to the surface of your project. Only file on the forward strokes while moving towards the edge of your project. Raise the file up slowly while following, slowly bringing it even with the edge of your piece. This will file the burr down and eventually remove it completely.

- Repeat this procedure over every edge and on both surfaces until all edges are soft and comfortable in your hands.



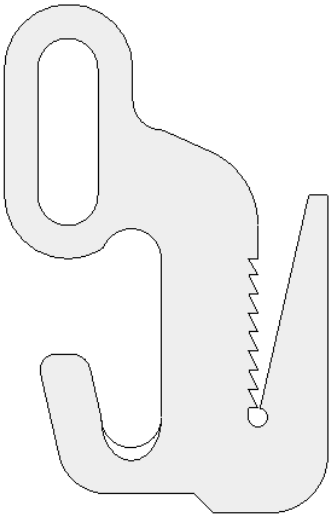
- Use a round miniature file to curve the front and back side of the lower hook portion. See the image to the left.

Sand both surfaces smooth.

- Place a piece of paper towel on the back of the vice and hold your project down.

- There will be lines in the metal running up and down the length of your project. These lines will take too much time to sand out. Instead of trying to sand them out, make sure you are sanding in the same direction as these lines. Make sure that even along the shorter portions (under the lower hook, around the upper loop) you are still sanding along the length of your project to keep the scratches even and uniform.

- Continue sanding on both surfaces until all scratches, marks, imperfections, etc. have been completely removed.



Use steel wool to finish smoothing out the surfaces.

- Make sure you have a scrap piece of cloth underneath your project, so it doesn't get scratched up.

Figure 9 Rope Fastener - Template

Tools Needed

- Ruler
- Centerpunch
- Square
- Hammer
- Hacksaw
- Jeweler's Saw
- File
- Mini File
- Sandpaper
- Steel Wool

Machines Needed

- Drill Press

Materials Needed

- 80 mm long piece of 2" x 1/8" Aluminum Flat Bar (Blue layout dye applied to one side)

Skills Developed

- Measurement and Layout
- Drill Press
- Jeweler's Saw

Tape the template onto your metal blank

- Take your time to make sure the template is centered on your piece of metal.

- Tear each small piece of tape off the roll, making sure it's slightly longer than the metal piece, and then carefully wrap it around the metal with each end wrapping around the back. Start at one end, then place a piece at the other end and continue putting pieces in the middle

- Do not use more tape than necessary. If you use too much tape and the pieces overlap at all, we won't be able to see the lines on the template and it will be difficult to accurately cut the project out.

Mark out the edges of your project with a hammer and centerpunch.

- Punch small dots along all the lines so that when the paper template comes off, you can still see the edges of where you need to cut.

- These dots do not need to be deep. As long as it is deep enough to go through the paper and tape and into the metal, that is deep enough. Any deeper than that will just need more filing and sanding later on.

- The dots need to be close enough so that when the paper and tape comes off, you can still clearly see the shape.

Centerpunch the spots for holes

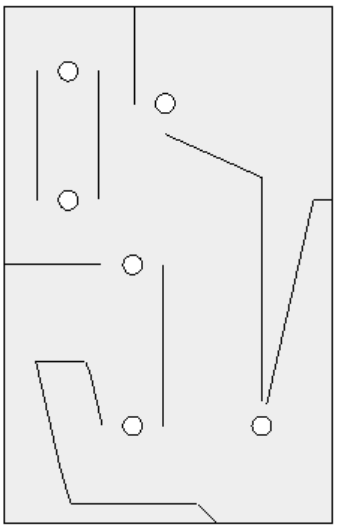
- Use a hammer and a centerpunch. Make sure the centerpunch is at the exact spot where the two small lines cross over each other. Swing hard and use just one strike. If you try and do several small hits with the hammer, the centerpunch may move and you won't have a clear spot to drill the hole.

- Repeat this for all six cross hairs

Drill the holes out with a 1/8" drill bit

- Use a 1/8" drill bit on all 6 holes.

- Clamp your project in place tightly in the vice with a scrap of wood underneath. Move the vice around and, by pulling on the handle, bring the drill bit down to line it up with one of the centerpunches.



- Hold the vice down with your left hand to make sure it doesn't shift or lift up while drilling. Reach up and turn the drill on with your right hand.

- Pull the handle down to start drilling through the metal. Use constant, steady pressure. Pulling too lightly can cause the drill bit to heat up and become dull. Pulling too hard can cause the drill bit to jam or break. Once through, raise the drill back up and turn it off.

- Reposition the vice to line up the next hole and continue to do so for all six holes.

Drill the holes out with the 3/8" drill bit.

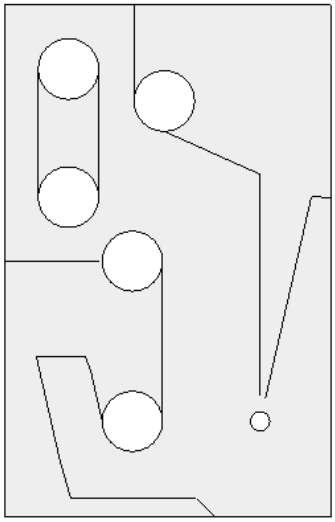
- 5 of the 6 holes need to be drilled out to a larger size, 3/8".

- Clamp your project into the vice with a piece of scrap wood underneath. Take your time to line up the center of the drill bit with the hole previously drilled in this spot. Take your time and look from multiple angles to make sure the large, flat spot at the center of the drill bit is seated in the hole.

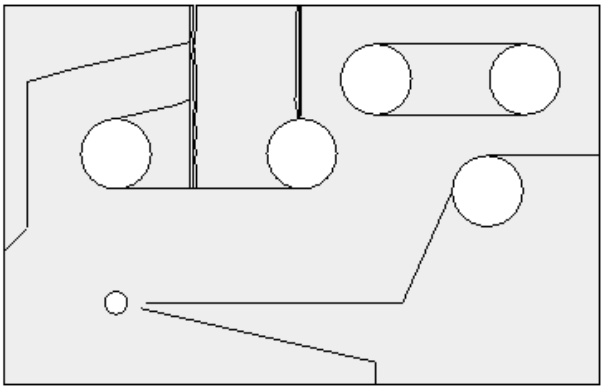
- Use the hold down to clamp the vice down to the table to make sure it is held firmly in place. Double check that the drill bit is still aligned properly.

- When drilling through with the larger drill bit, do not go through all at once. After drilling through a bit of the material, back out of the cut to clear out the metal shavings. Do this two or three times as you're drilling to stop the bit from jamming or grabbing the metal out of the vice.

- Repeat this for the other 4 spots. Make sure you leave the final hole at 1/8".

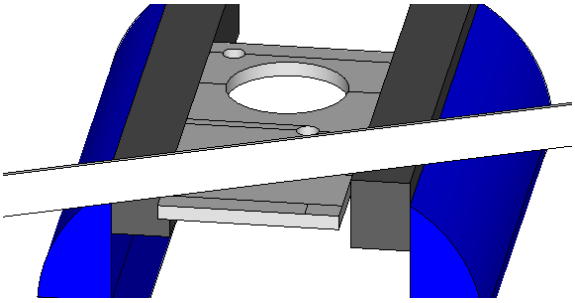


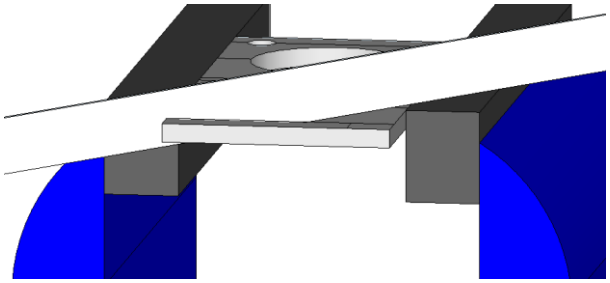
Cut the first edges with a hacksaw



- Start by cutting the lower hook. See the image to the left.

- Lay your project flat in the vice to start the cut. This will give you a better chance of keeping the cuts aligned properly and not crooked. Start the cuts with the saw on a slight angle to start cutting the front edge. Keep checking the make sure that the sign is lined up with the line that we drew. Once the cut is started, it is very difficult to change the angle it's on. The beginning is very important.



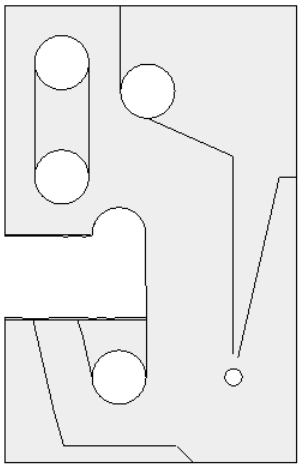


- Once there is a noticeable groove cut into the metal, move to the next spot.

- After you have grooves started, flip the piece so it is vertical in the vice. Continue the cuts down to where they stop.

First cut with the Jeweler's Saw

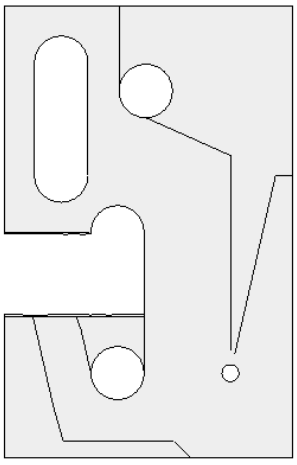
- Start by placing a blade into one of the jeweler's saw frames. Clamp the saw into your vice. Loosen the thumb screw on the upper blade clamp, the lower clade clamp and the handle; also loosen the tensioning wingnut. Take your blade and, with the teeth point up and angled towards the handle, clamp it in place in the lower blade clamp attached to the handle. Adjust the handle back and forth until the other end reaches the upper blade clamp and tighten it up to secure the blade. Pull the handle as far down the frame as possible to put tension on the blade and, while holding the handle in place, tighten the frame thumb screw. Put the final tension on the blade by tightening the tension wingnut at the end of the frame. If the blade still wiggles, re-tension it. Loosen the wingnut several turns, loosen the frame thumbscrew, pull the handle tight, and then retighten both screws.



- Clamp your piece in the vice vertical. Thread the jeweler's saw through one of your previous cuts then turn the saw and start cutting down. See image to the right.

- If the blade breaks, take out the broken pieces and put a new blade in place.

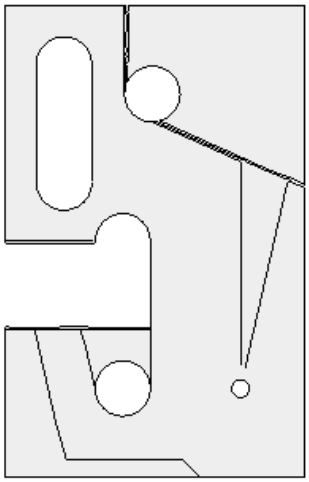
Inside cut with the Jeweler's Saw



- Unwind the tension wingnut on the end of the saw, then unscrew the upper thumb screw to unclamp the end of the blade. Thread the blade through one of the holes in the corner of the project, where the scribed lines are connecting the edges of the circle. With the blade through the hole, reclamp the end of the blade with the upper thumb screw. Re-apply tension to the blade with the wingut.

- Cut down both lines scribed between the circles to remove the material between them.

Cutting the upper section

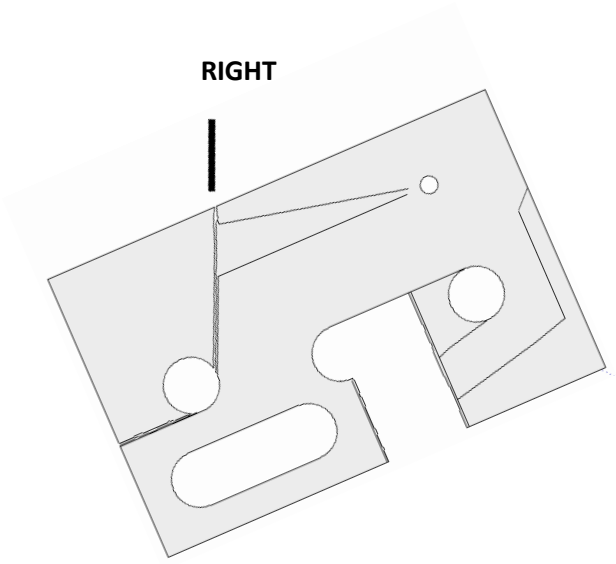


- Lay your project flat in the vice like the first two cuts you did. Cut along the two lines that lead to the circle in the center of the top of the project. See the image to the right.

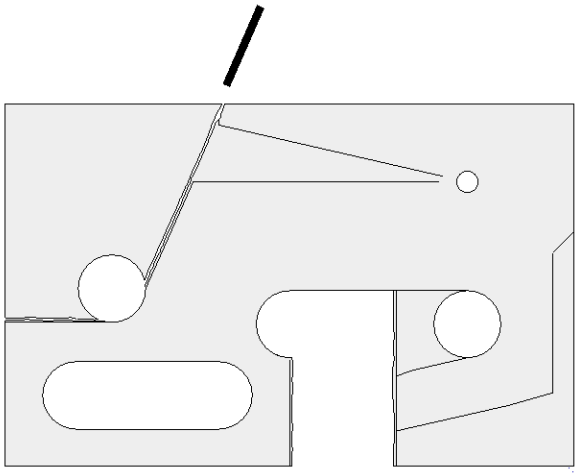
- Once you have grooves started for both cuts, turn the project so it's straight up and down and cut along both lines into the circle.

- When cutting any angles, we always want the saw to be straight up and down. Instead of turning the saw, turn the project in the vice so the cut is straight up and down. See below for an explanation.

RIGHT

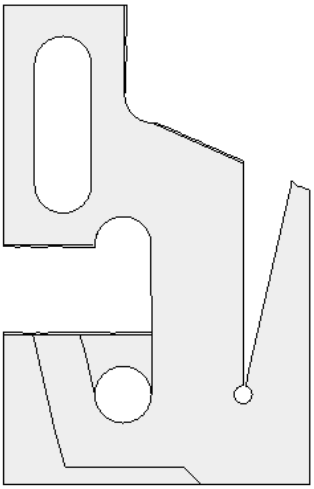


WRONG

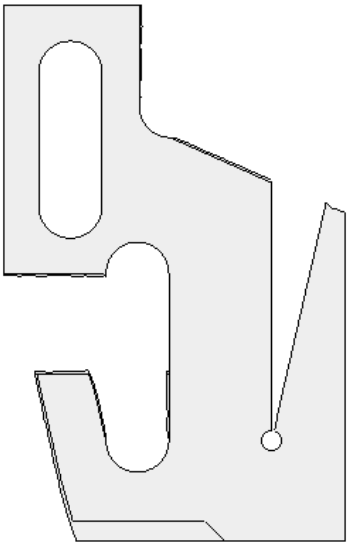


- Put the your project back in the vice flat. Cut along the two angled lines that lead to the 1/8" hole in the bottom right corner.

- Once you have grooves started for both cuts, turn the project vertical to finish the cuts. Remember to angle to project and not the saw on any cuts that are on an angle.

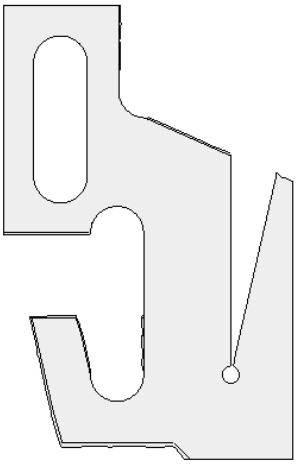


Cutting the lower section



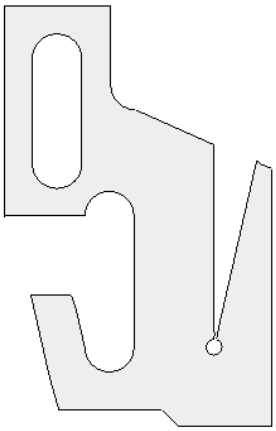
- Cut along the two angled lines around the lower hook. Also continue the previous cut from the jeweler's saw all the way into the lower hole.

- Remember, when cutting on an angle, don't hold the saw on an angle. Clamp your project on an angle so that our saw remains straight up and down.

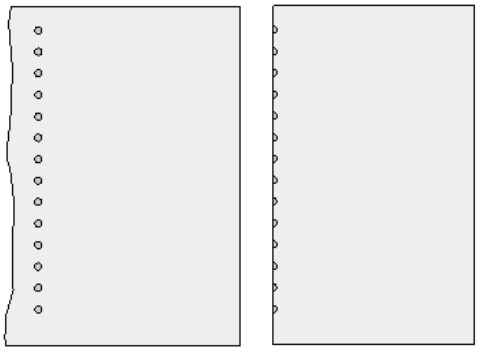


- Cut along the two remaining lines at the bottom to remove the final piece from the shape.

Filing to shape



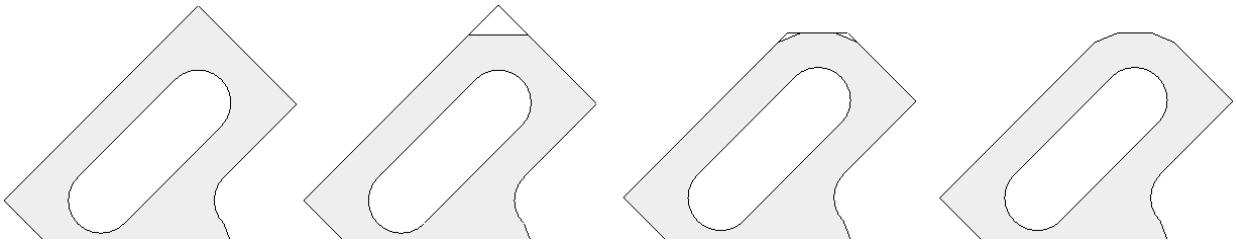
- File all the edges smooth to remove all cut lines left from the saws. See the iamge to the left



- Continue to file down until all the center punches that helped guide are cuts are cut in half. See the image to the right.

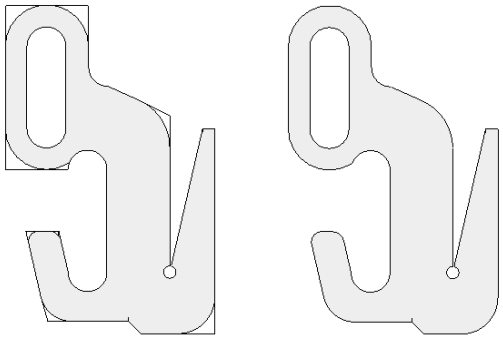
- We now want to file all corners to shape. Make sure that wherever you are filing is clamped in tight and close to the surface of the vice to reduce vibrations and noise.

- Start by filing the corners to take the high points down. While moving the file back and forth, slowly angle the file from side to side to create a smooth curve from one edge to the next (See the images below as a guide).



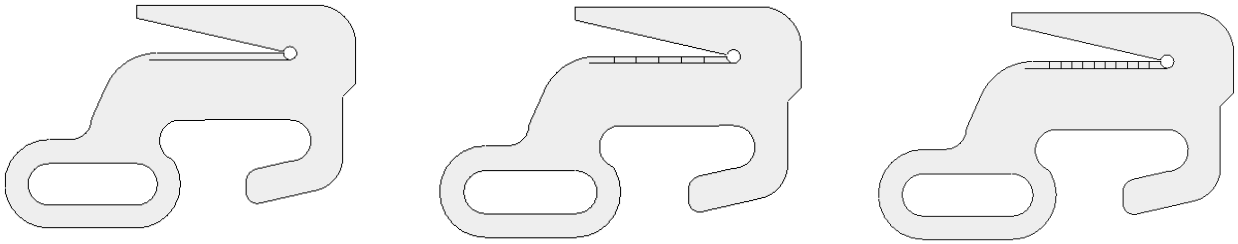
- Continue filing all corners until they are around and smooth.

- If you cannot fit a full sized file into an area that needs to be filed, use one of the miniature files.

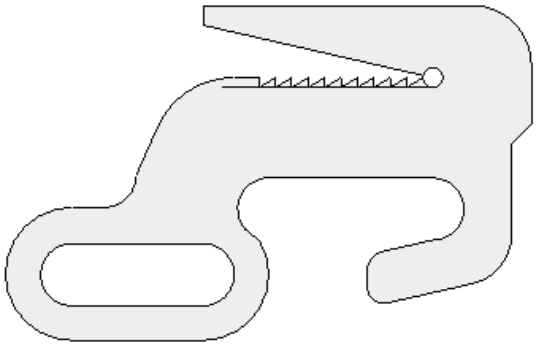


Layout and filing the teeth

- Using a ruler, scribe a line from the edge of the 1/8” hole straight along the edge. Along this line, measure and mark every 5 mm. Make sure the mark goes between the edge and the line you just scribed. Then go and split each of these sections in have by measuring and marking 2.5 mm between each spot.

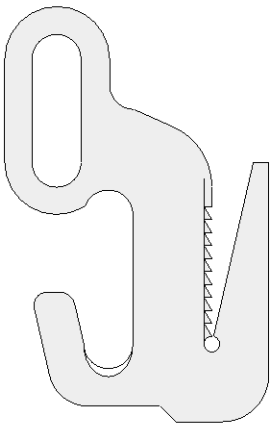


- Use a miniature square file to then file angles on each section measured and marked. Make sure the angled sides are facing the opening and the flat edges are facing the hole.



Deburr the edges.

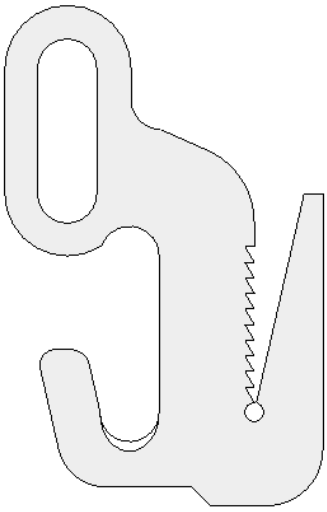
- Hold your piece on the back of the vice. Start with the file held low, close to the surface of your project. Only file on the forward strokes while moving towards the edge of your project. Raise the file up slowly while following, slowly bringing it even with the edge of your piece. This will file the burr down and eventually remove it completely.



- Repeat this procedure over every edge and on both surfaces until all edges are soft and comfortable in your hands.

- Use a round miniature file to curve the front and back side of the lower hook portion. See the image to the left.

Sand both surfaces smooth.



- Place a piece of paper towel on the back of the vice and hold your project down.

- There will be lines in the metal running up and down the length of your project. These lines will take too much time to sand out. Instead of trying to sand them out, make sure you are sanding in the same direction as these lines. Make sure that even along the shorter portions (under the lower hook, around the upper loop) you are still sanding along the length of your project to keep the scratches even and uniform.

- Continue sanding on both surfaces until all scratches, marks, imperfections, etc. have been completely removed.

Use steel wool to finish smoothing out the surfaces.

- Make sure you have a scrap piece of cloth underneath your project, so it doesn't get scratched up.