Small Scale
Fold-Forming and Corrugation

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Safety First
The edges of the thin metal we will be working with can be as sharp as a knife blade. Please be very careful.

Foldforming

Theory
- Metal moves when you compress it.
- Metal hardens when you compress it.
- Multiple layers move and harden together and equally.

Basic Method
There are 4 basic steps to making a fold formed shape:
1. Fold the metal
2. Compress part of the metal, with a hammer, a rolling mill, a vise, etc.
3. Anneal the metal
4. Open the fold

Steps 2 and 3 may be repeated as often as necessary. When the metal hardens and does not move easily, anneal it. “Annealing is your friend.”

Tools
- Hammers
- Vise
- Steel block
- Torch

Materials
- Copper sheet
  - 26 gauge – general use
  - 28 gauge – small pieces and jewelry
  - 24 gauge – large pieces for yard art, generally too heavy for complex folds
- Brass sheet – harder to work than copper

Some Basic Folds
This section introduces some of the basic folds, not all of which may be applicable to small scale jewelry.
**Line Fold**

Making the basic line fold:

1. Fold the metal and set the fold in a vise or with a hammer
2. Anneal
3. Open the folded metal

You can make multiple folds, cross the folds, and make some of the folds partial by not setting that part of the fold that you do not want.

Making an alternate line fold:

1. Fold the metal and set the fold in a vise or with a hammer
2. Hold the folded metal in a vise with the fold slightly above the jaws of the vise and hammer segments of the fold to alternate sides.
3. Anneal
4. Open the folded metal

**T-fold**

Making a basic T-fold:

1. Fold the metal with your fingers and do not set the fold
2. Hold the folded metal in a vise with the fold slightly above the jaws of the vise. From the side it will look like a lollypop.
3. Flatten the fold down onto the top of the vise jaws with a hammer
4. Anneal
5. Open the folded metal

A Chased T-fold is made by chasing the top of the fold in step 3 above instead of flattening against the vise jaws.

A Wedge T-fold is made by placing the folded metal in the vise at an angle before flattening it against the jaws of the vise.

**Forged Open Side Fold**

Making a Forged Open Side Fold

1. Fold the metal and set the fold in a vise or with a hammer
2. Cut the metal into the desired shape
3. Forge the non-folded edge of the metal starting in the middle of the edge and working toward the ends
4. Anneal
5. Open the folded metal
The Forged Open Side Fold may be forged into a complete circle, and beyond, by annealing when the metal has become work hardened followed by additional forging. The annealing/forging sequence may be repeated several times if necessary.

The ruffled edge is created by building “dams” of work hardened metal at several locations along the edge before starting the forging in the center of the edge.

**Rueger Fold**

Making a Rueger Fold

1. Fold the metal and set the fold in a vise or with a hammer
2. Cut the metal into the desired shape
3. Forge the folded edge of the metal starting in the middle of the edge and working toward the ends
4. Anneal
5. Open the folded metal

The Rueger Fold may also be forged into a complete circle, and beyond, by annealing when the metal has become work hardened followed by additional forging. The annealing/forging sequence may be repeated several times if necessary.
Forged Mixed Sides

Making a Forged Mixed Sides Fold

1. Fold the metal and set the fold in a vise or with a hammer
2. Cut the metal into the desired shape
3. Decide which areas will be forged on the open side and which areas will be forged on the fold edge. Forge the edges of the metal starting in the middle of the edge and working toward the ends
4. Anneal
5. Open the folded metal

Repeated annealing and forging may also be used.

Heistad Cup

Making a Heistad Cup:

1. Cut a square of metal, fold it in half corner to corner and set the fold with a hammer, and then fold it in half again on the long side point to point and set with a hammer. The result will be a triangle with 4 layers of metal.
2. Run the metal through a rolling mill starting at the point having only folded edges first. Lower the roller and run it through again from the same point. Do this several times.
3. Anneal
4. Open the folded metal
Pleated Folds

Pleated folds are made by folding the metal into accordion-like pleats and forging or running through a rolling mill.

This Pleated M Closed Fold was forged on the closed side.

The Rolled Pleated M Closed Fold was run through a rolling mill. Note the legs extend past the inside fold and provide the anchor for the curve.

Other Folds

Star Forged Open Fold with the metal folded corner to corner.

Star Forged Open Fold with the metal folded side to side.
Corrugation

Basic Method
There are 2 basic steps to adding corrugation to your piece.

1. Anneal the metal
2. Run it through the corrugation device

Anneal the metal before each pass through the corrugation device. “Annealing is your friend.”

Tools
- Corrugation device
- Torch

Materials
- Copper sheet
  o 26 gauge – general use
  o 28 gauge – small pieces
- Brass sheet – harder to work than copper
  o 28 gauge – small pieces

Corrugation Devices
There are at least two types of corrugation devices available for this type of work. A tube-wringer is hand-held and a microfold brake is bench mounted. Both are available from Rio Grande.

Tube Wringer

Microfold Brake

The metal must be annealed before using the corrugation tool. You may run the metal through the corrugation device multiple times if desired, annealing it between each pass. Interesting effects may be accomplished by running the metal through at a different angle on the multiple passes. See the following examples.

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References

Books


CDs

Video

Web sites


Facebook groups:
“foldforming”

“Aspiring Metalsmiths”
Supplies

Raw Materials
Copper and brass sheets

- Indian Jewelers Supply Co. – www.ijsinc.com
- Metalliferous - www.metalliferous.com
- Monsterslayer – www.monsterslayer.com
- Rio Grande – www.riogrande.com

Tools
Rio Grande – www.riogrande.com

Thank you for attending my workshop.
I hope you enjoyed the workshop and get many years of enjoyment using these techniques.

There is fold-forming information available on our Web site at www.bijoux-de-terre.com. Just click on “For Our Students” on the left and “Fold-Forming” near the top center. The latest version of this handout is also available there.

If you have any questions, please email me at john@bijoux-de-terre.com.

Example Projects
Battered Heart Pendant

Adapted from "Battered Heart", a bracelet project by Abbi Berta published in Step by Step Wire Jewelry, August-September 2012.

Size estimate: A 1½ x 1¾ inch heart shaped pendant

Materials required:

- 1 – 2 x 2 inch square of 26 gauge copper

Tools required:

- Torch
- Bench block
- Small cross peen hammer
- Metal shears or jeweler’s saw
- File and sandpaper
- Metal hole punch, 1.8mm
- Small vise
- Recommended: Tumbler, burnishing compound and stainless steel shot

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Construction:

1. Anneal the 2 x 2 inch square of copper. Measure and draw a line through the center of the square parallel with one of the edges. Fold the square, side to side, on the line using the edge of the bench block, a small vise, or a bending brake.

2. Close the fold using your fingers and confirm the fold using a hammer and a bench block.

3. Using the folded side of the copper as the center of the heart, sketch half a heart shape, or trace the “2” Heart” pattern from the last page onto the folded copper.

4. Using a shear or a jeweler’s saw, cut the heart shape. Do not cut along the fold. Using a file and sandpaper to smooth the cut edges.

5. Remove the pattern and anneal the copper.

6. Insert about 1/16th of an inch of the folded side into the jaws of a vise.

7. Using a knife blade and your fingers, open the heart as wide as possible. Confirm the new folds gently with a hammer.
8. Use a cross peen hammer to create a series of hammer marks, perpendicular to the edge, all along both sides of the heart. Start in the middle of a side and work towards both ends. This will cause the edge to expand slightly into a wrinkled edge.

9. Snip off the sharp point at the bottom and smooth the area using a file and sandpaper. Add more texturing if desired, and punch two small holes near the top outside of each lobe to attach to the chain. Be careful not to punch the holes too close to the edge.

Clean the copper by pickling it and scrubbing it with a tooth brush.

10. Burnish in a tumbler for 30 minutes.

11. Optional: Apply a patina if desired, and tumble for another 5-10 minutes.

Pattern:
Forged Line Fold Earrings

Size estimate: 2 inch drop

Materials required:

- 2 - 1" x 2" rectangles of 28 gauge copper
- 2 - 20 gauge 0.094" jump rings
- 2 - titanium ear wires

Tools required:

- Torch
- Small vise
- Bench block
- Small cross peen hammer
- Metal shears or jeweler’s saw
- 2 pliers (I use a bent chain nose and a flat nose)
- Metal hole punch, 1.25mm
- Recommended: Tumbler, burnishing compound and stainless steel shot

Synclastic, Anticlastic, or mixed edge?

The following directions and pictures show the making of synclastic shapes for the earrings. To make anticlastic shapes for the earrings hammer along the cut edge (the curved edge) instead of the folded edge in steps 4 and 6. To make mixed edge shapes hammer along the cut edge (the curved edge) for half the length of the shape and along the folded edge for the other half of the length in steps 4 and 6.

Construction:

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1. Anneal the copper rectangles. Measure and draw a line through the center of the rectangles parallel with the long edges. Fold the rectangles on the lines. Close the folds using your fingers. Confirm the folds using a hammer and a bench block.

2. Anneal both pieces. Using the folded side of the copper as the straight side of the pattern, trace the “2 inch Mixed Edge” pattern from the last page onto both pieces.

3. Using a shear or a jeweler’s saw, cut the shapes. Do not cut along the fold. Use a file and/or sandpaper to smooth the edges and round the corners.

4. Starting in the middle of the folded edge, use a cross peen hammer to make a series of hammer strokes, perpendicular to the edge, toward both ends of the piece. The hammer strokes should go about half way to the other edge. Turn the piece over and do the same on the other side. Repeat this step. In other words, make 2 hammer passes on each side of the folded edge.

5. Anneal both pieces.

6. Make one more hammer pass on each side of the folded edge. Hold one piece on top of the other and make sure they have approximately the same shape. If not, make them the same with carefully placed hammer strokes.

7. Anneal both pieces. Punch a small hole with a metal punch close, but not too close, to the folded edge about 3/8 of an inch from the top.
8. Using a knife blade and your fingers, open each shape. Adjust the shapes using fingers and pliers until they match.

   Clean the copper by pickling it and scrubbing it with a tooth brush.

9. Using a file and sandpaper round the points so they will be comfortable to wear. Insert a small jump ring through the hole, and attach the ear wire.

10. Burnish in a tumbler for 30 minutes.

11. Optional: Apply a patina if desired, and tumble for another 5-10 minutes.

**Patterns:**

- 2 inch Mixed Edge
- 2 inch Mixed Edge
- 2 inch Mixed Edge
- 2 inch Mixed Edge
**Corrugated Leaf Earrings**

**Size estimate:** 2 inch drop

**Materials required:**
- 2 – 1.25 x 2.25 inch rectangles of 28 gauge copper
- 2 – ear wires

**Tools required:**
- Torch
- Small vise
- Bench block
- Hammer
- Corrugator
- File and sandpaper
- 2 pliers (I use a bent chain nose and a flat nose)
- Metal hole punch, 1.25mm
- Recommended: Tumbler, burnishing compound and stainless steel shot

**Construction:**

1. Anneal both pieces of copper. Measure and draw a line through the center of the rectangles parallel to one of the long edges. Fold the rectangles on the lines. Close the folds using your fingers. Confirm the folds using a hammer and a bench block.
2. Using the folded side of the copper as the center of the pattern, trace the “2 inch Leaf” pattern onto both pieces.

3. Using a shear or a jeweler’s saw, cut the shapes. Do not cut along the fold. Use a file and/or sandpaper to smooth the edges and round the corners.

4. Anneal both pieces.

5. Set the spacing of the corrugator rollers as directed by the instructor, and feed the folded copper, starting with the pointed end, at a 45 degree angle. Do both pieces.

6. Anneal both pieces.

7. Using a knife blade and your fingers, open the fold as wide as possible. Gently flatten each leaf using a plastic or rawhide hammer and a bench block. Using a file and sandpaper smooth all the edges and round all the corners.

8. Punch a small hole with a metal punch close, but not too close, to the top of each leaf.

   Clean the copper by pickling it and scrubbing it with a tooth brush

9. Using a file and sandpaper smooth the edges and round the points so they will be comfortable to wear. Attach the ear wires through the small holes.

10. Burnish in a tumbler for 30 minutes.

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11. Optional: Apply a patina if desired, and tumble for another 5-10 minutes.

**Patterns:**

- 2 inch Leaf
- 2 inch Leaf
- 2 inch Leaf
- 2 inch Leaf
Corrugated Line Fold Pendant

Size estimate: Approximately a 2 inch pendant.

Materials required:

- 1 – 2 x 2 inch square of 26 gauge copper

Tools required:

- Torch
- Bench block
- Hammer
- Corrugator
- File and sandpaper
- Metal hole punch, 1.25mm
- Small vise
- Recommended: Tumbler, burnishing compound and stainless steel shot

Shape of the pendant

The following directions and pictures show the making of a heart shape for the pendant. The pendant may be any shape and may have more than one line fold, but note that three layers of 26 gauge copper are about all the corrugation device can handle.

Construction:

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1. Anneal the 2 x 2 inch square of copper. Draw a line through the square.

Optional: The fold does not need to be exactly down the center. Also the folded copper may be trimmed to a different shape, e.g. a semicircle, half a heart, etc. Remember, when the fold is opened the final shape will be revealed

2. Fold the square on the line using either a small vise or a bending brake. Close the fold using your fingers. Confirm the fold using a hammer and a bench block.

3. Anneal the copper.

4. Draw the outline of half a heart on the folded copper. Make sure the center of the heart lies along the fold in the copper. Using a shear or a jeweler’s saw, cut the shape. Do not cut along the fold. Use a file and/or sandpaper to smooth the edges and round the corners.

5. Anneal and dry the copper.

6. Set the spacing of the corrugator rollers as directed by the instructor, and feed the folded copper at an angle, starting with the outside of the lower part of the heart.

7. Anneal the copper.

8. Using a knife blade and your fingers, open the fold as wide as possible. Place the heart face down on a bench block and gently flatten it with a plastic hammer.

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9. Punch a small hole near the top of each lobe to attach to a chain. Using a file and sandpaper smooth all the edges and round all the corners.

   Clean the copper by pickling it and scrubbing it with a tooth brush.

10. Burnish in a tumbler for 30 minutes.

11. Optional: Apply a patina if desired, and tumble for another 5-10 minutes.

Pattern:

```
2" Heart     2" Heart

2" Heart     2" Heart
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Forged Star Fold Earrings

Adapted from "Foldformed Mini Copper Stars", by Judy Freyer Thompson published in Art Jewelry, January 2011.

Size estimate: 1 ½ inch drop

Materials required:
- 2 – 1¼ inch squares of 28 gauge copper
- 4 – 20 gauge 0.109” jump rings
- 2 – Titanium ear wires

Tools required:
- Torch
- Small vise
- Bench block
- Small cross peen hammer
- Metal shears or jeweler’s saw
- Pliers – round/concave bending, round nose, bent chain nose, and flat nose
- Metal hole punch, 1.25mm
- Recommended: Tumbler, burnishing compound and stainless steel shot

Construction:

1. Anneal the two squares of copper. Fold each square, corner to corner. Close the fold using your fingers.
2. Confirm all but ¼ inch of the fold using a flat nose pliers or a hammer and a bench block. Do this to both pieces of copper.

3. Anneal both pieces. Open the folds using a small knife blade. Flatten both squares.

4. Fold each square corner to corner at a right angle to the first fold. Confirm all but the center where it crosses the first fold using a flat nose pliers or a hammer and a bench block.

5. Anneal both pieces. Open the folds, but do not flatten them.

6. Using the edge of the bench block bend the sides towards the center. Shape the stars using a variety of pliers until you are satisfied with the final shape. Punch a hole through the corner that was not confirmed in step 2. Round any sharp corners using a file and sandpaper.

   Clean the copper by pickling it and scrubbing it with a tooth brush.

7. Attach the ear wires to each using two of the jump rings included with the ear wires.

8. Burnish in a tumbler for 30 minutes.
9. Optional: Apply a patina if desired, and tumble for another 5-10 minutes.
Forged 2-Edge Line Fold Pendant

Size estimate: 1 ¾ inch pendant

Materials required:

- 1 – 2” x 2” square of 26 gauge copper

Tools required:

- Torch
- Bench block
- Small cross peen hammer
- Metal shears or jeweler’s saw
- File and sandpaper
- Metal hole punch, 1.25mm
- Recommended: Tumbler, burnishing compound and stainless steel shot

Construction:

10. Anneal the copper square. Fold the square down the center. Close the fold using your fingers. Confirm the fold using a hammer and a bench block.
11. Using the folded side of the copper as the long straight side of the pattern, trace the “1x1.75” Rectangle pattern from the last page onto the copper.

12. Using a shear or a jeweler’s saw, cut the shape. Do not cut along the fold. Smooth the edges and round the corners using a file and sandpaper. Anneal the copper.

13. Starting in the middle of one of the cut edges, use a cross peen hammer to make a series of hammer strokes along the edge, perpendicular to the edge, moving toward the folded edge. Go back to the middle and make a series of hammer strokes moving to the corner away from the folded edge. Repeat this process on the other cut edge. Turn the piece over and do the same on the other side. Repeat this step. In other words, make 2 hammer passes on each side of the unfolded edges.

14. Anneal the copper. Make two more hammer passes on each side of the unfolded edges.

15. Anneal the copper. Punch a small hole with a metal punch close, but not too close, to the cut edge about 1/2 of an inch from the corner where the folded edge meets the long cut edge.

16. Using a knife blade and your fingers, open the shape. Adjust the shape using fingers, a chasing hammer, and the end of a small dowel, until you are satisfied. Using a file and sandpaper smooth the edges and round the points so it will be comfortable to wear.

17. Clean the copper by pickling it and scrubbing it with a tooth brush.

18. Burnish in a tumbler for 30 minutes.

19. Optional: Apply a patina if desired, and tumble for another 5-10 minutes.

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Patterns:

1 x 1.75" Rectangle

1 x 1.75" Rectangle

1 x 1.75" Rectangle

1 x 1.75" Rectangle