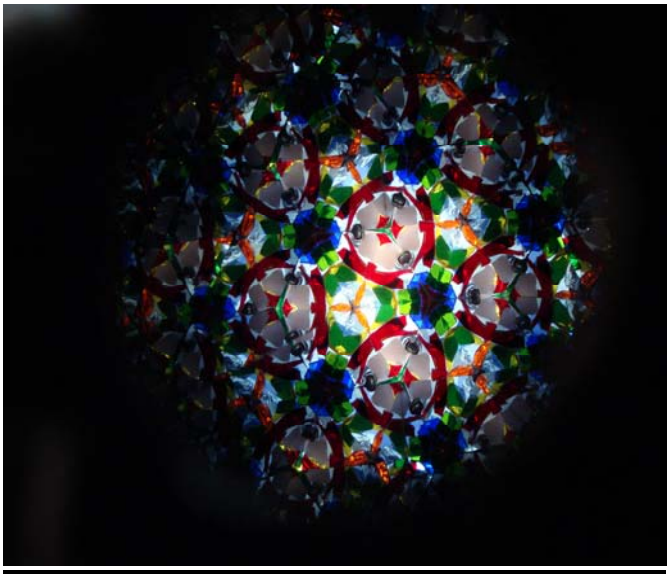
Making A Kaleidoscope



A Guide by Jim Perkin

10" Octagon Kaleidoscope

Materials Needed For a 10" Octagon Kaleidoscope

Front surface mirror -1/2 Sq Ft
Art Glass – 1 Sq Ft
Float Glass – 4 - 2" X 2" pieces
Glass Chips – Cathedrals various colors, sizes and textures
Foil – I use 7/32 by 1.5 mil
Solder- I use 63/37
High Quality Electricians Tape – Scotch Brand 33
Brass Rod – I use 1/8" brazing rod. o.d (Outside Diameter) .
Brass Rod 3/32" for legs
Brass Flat Stock 3/8" wide 12" long
Brass Tube – 1/8" i.d. (Inside Diameter)
Beads for Legs – 4 each (I use Bone Beads)

The Body:

Build the body first then fit the mirror set to the body.

Prepare the glass for the outside of the body by squaring one end with the long side. Once you have a good clean square end mark, and square the other end 10" long. You should now have a piece that is 12"x 10" that both ends are square with one side. I suggest you mark the side you squared to, so you cut the strips from the correct side. Next cut eight ¾" strips 10" long. If you are using a streaky glass and you want the glass pattern to follow around the body number each piece on one end on the ***inside*** if the glass, I use my dremel tool. Grind the edges slightly if needed to get rid of any razor edges and foil each piece. Lay the pieces presentation side up on the work table with a push pin between each strip of glass, make sure the whole set is square, put a strip of electricians tape on each end, all the way across, back about 1" from the end. I wrap this group around a plastic caulking tube and tape it together where they meet. Don't worry if they don't quite come together. Tack solder along each seam in 3 or 4 places except the last one unless it comes together. Slip the caulking tube out enough to let the last seam come together and tack it at the very end, then remove the tube completely and finish tacking this seam. At this point, I like to go ahead and seal each of the longitudinal seams leaving just a little unsoldered at both ends. When sealing the seams try not to overheat and have solder bleed through to the inside. That will make it hard to get the mirror set in. Do not fill solder the seams yet.

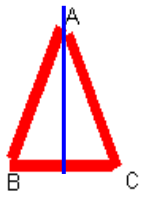
This is an end view of what you should have at this point. Red points of the triangle will be the mirrors and should touch the glass at points A, B & C, when installed.

<u>The Mirror Set:</u>

The mirror set is represented by the red triangle in the octagon above. You will need to know the thickness of your mirror for the next set of measurements. On the inside of the body measure from point A to Point B, subtract the thickness of the mirror, write it down. A/B = 1 15/16" B/C = 1 7/16" C/A = 1 15/16" I would rather they be a little loose than too big. If you are using front surface mirror, find the reflective side. To find this take a pencil or pen and place the tip on the mirror if the points touch this is the reflective side, if they don't touch it is the glass side. The space you see is the thickness of the glass. ***The cutting of the mirrors is critical to a quality kaleidoscope!***
If you have a strip cutter you can use it. I don't so I use a steel ruler. To keep it from slipping put a strip of your electrical tape on the back side. Mark your first piece, on the non-reflective (glass) side, and make sure your score line is exactly the width you want on both ends. Then make your score. I make this cut along a 12" piece of mirror and then trim the length to fit the length of the body because mirror tends to flare a little at the end. ***No Grinding on Mirror.*** Cut your second and third piece according to your dimensions. Square and cut about 1" off one end of each piece. Measure the length of the body. Using this measurement cut off the other end of each mirror piece making the mirror set ***<u>exactly</u>*** the same as the body length. Again it is better to be a tiny bit short than too long.

Here comes the really critical part. Clean the mirrors ***very well and dry with a lint free cloth.*** From this point until the body is completely sealed, keeping the mirrors clean and dust free is essential.

Cut 6 pieces of electrical tape about 1 ½" long stick them on the edge of your work bench where they are easily accessible. The mirrors are assembled according to the following diagram. ***Remember the reflective surface goes to the inside, use the pencil tip test.***



Note: In the diagram above, mirror section A/B sets on top of section B/C, section C/A sets against the end of B/C and rests against section A/B at the top. The blue line indicates the alignment of the mirror set in relation to the center of mirror B/C.

I like to set the bottom B/C on the edge of my work bench with the end sticking out a couple of inches. Set mirror A/B and mirror A/C in place as in the diagram and place a piece of tape on each corner, turn the assembly around and do the same on the other end. Now take the roll of electrical tape and in the middle of the mirror set go all the way around the mirror set twice. Cut your tape off in the middle of one of the long sides. If your temporary tape pieces are far enough back tape each end the same way as above. Remove the temporary tape pieces. Going the opposite direction with the tape make additional wraps twice around the mirrors. I tape around the mirror set in five places, about 1 inch in from each end, one in the middle and then one between each of each of the previous ones. Remember to keep the electrical tape stretched a little to keep the mirror joints good and tight. Stretching the tape in opposite directions helps keep the mirror angle A 90 degrees to the center of mirror B/C. See the blue line in the diagram above.

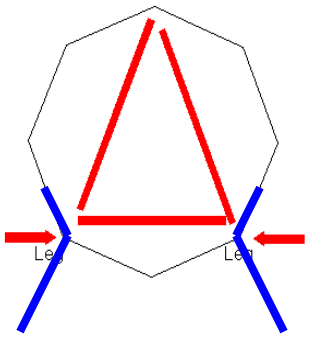
Choose the presentation you like for the body and insert the mirror set into the body. If it is too loose, add additional wraps of tape in equal amounts on each of the 5 places you taped the mirror set. Once inserted it should look like this. If I need to stop for awhile after I have cleaned and assembled the mirrors I cover the ends with blue masking tape to keep any dust or dirt out.

Now we are going to close up the ends. This is your last chance to make sure the mirrors have no dirt, dust, lint or fingerprints. I have a piece of galvanized metal cut to an octagon that I use as a pattern. You can set the body end down on a piece of float glass and mark around the outside with a Sharpie. It is better to draw an octagon with a pencil compass and use that as a pattern because the body is still a little flexible at this point.. These end pieces need to be cut just a little smaller than the outside of the body, about ½ the thickness of the glass all the way around. Once I am satisfied with the fit of the end pieces I cover them with sheet foil. On the object wheel end, I mark and cut a triangle to match the outside of the triangle of the mirror set. You do not want any of the foil to extend inside the mirror set. In the center of the eyepiece end I cut a ½ " round circle. Foil tape the edges of the end pieces and tin the inside, the edge and the outer surface. Clean the ends very well.
Position the object wheel end where it matches the body. We are going to tack solder the end piece to the body. ***Very important!! Be <u>VERY</u> sparing with the flux.*** I use a liquid flux. The brand is "Laco-Brite". I use a Q-Tip to apply my flux. I pour a little flux into the bottle cap and dip the Q-Tip in the flux and then blot the Q-Tip on a paper towel.

Holding the body where the edge I am about to tack is perpendicular to the floor wipe the area to be tacked with the damp Q-Tip. The reason for holding the body in this manner is that if there is any excess flux it will run away from the mirror set. The most critical points are where the octagon body match up with the corners of the mirror set. If there is too much flux here and the hot iron causes a splatter the inside of the mirror set is fouled.

If this happens on the second end you are going to have to do some disassembly and clean the mirrors again. Before the second end is tacked in place check the inside of the mirrors one last time for cleanliness, if there is a spot I tape a Q-Tip to a 10" piece of copper wire dampen with a small amount of glass cleaner and try to clean again. Once both ends are tacked in place and you are happy with the cleanliness of the mirror set, seal solder all the seams.

Use the same method of dipping a Q-Tip in the solder and blotting on a paper towel, remembering to hold the body in a position that will allow any possible flux to run away from the inside of the body. At this point apply just enough solder to seal all open seams.



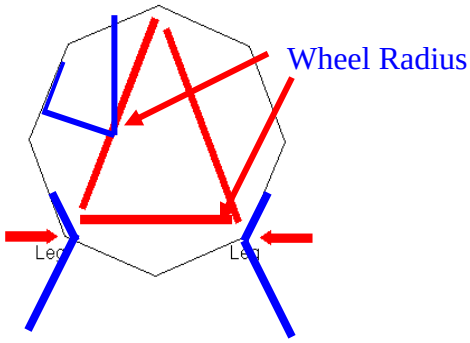
Attach the legs at the points indicated above front and rear. I use 3/32" brass rod. Cut a length of rod about 2" long, I place the legs at both ends of the body so I place each of my wire legs in place on the valley created where the end glass is joined with the body starting at the points shown and going up following the angle. Hold the legs in place with pliers tack solder in place. Don't worry if they are not the same length at this point. I usually solder in about ½ " to the body leaving 1 ½ " sticking down. I measure and cut the two front legs the same length and then the same for the back . Set the unit on a good flat surface and trim one leg or the other until the bottom of the mirror set is level with the surface it is setting on. Repeat the process on the back set of legs until the unit does not rock. We will come back to the legs later.

The Axle:

I use 1/8 " o.d. brass rod which I buy at Ace hardware. I cut off a 3" piece of rod and place it in my vice. I have a tap and die set so I cut my own threads on the axle piece. The axle is threaded with an 6-32 die. The 1/8" rod is a little large for threading with a 6-32 die but it can be done. Cut the threads slowly and use plenty of 3-in-1 oil, work close to the vice, the rod is less likely to twist off.

If you don't have the tools necessary to do this try to buy a 6-32 brass screw at least 3" long. It needs to be solid brass not plated. I don't like using screws because when we make the bends in the threaded area they are weaker. I thread at least 1" or a little more. This allows plenty to accommodate the thickness of the finished wheel. When you make the bend for the threaded section of the axle it should be a ¼" or so behind the threads. The wheel will come out past where the threads start. The first bend is the axle which is 90 degrees in relation to the blue line in the diagram below, going out to the side of the octagon.

This bend needs to be a good tight radius bend. I tap mine with a hammer in the vise until it goes a little beyond 90 degrees then spread the bend back out to 90 degrees. Set the axle on the end piece at the edge of the triangle cut out and mark the groove at the edge of the octagon. The end cap is slightly smaller than the outside perimeter creating a groove for the axle to lie in. The second bend is 90 degrees to the middle section and a little more than 90 degrees away from the axle section and up toward the top of the scope. This is by trial until the axle is 90 degrees to the end cap in both directions, left and right and up and down. If it is not the object wheel will not be straight in relation to the body. Do most of this fitting prior to tack soldering in place. If it is good, finish soldering the axle to the body. After all the solder work is done, slight adjustments can be made to the axle, however you run the risk of cracking the glass on the end of the body.



Once all four legs and the axle are tacked in place you can finish all the decorative solder work to the body and the ends. On the ends I like to place a drop of solder (60/40) and shake the body as it cools, this the legs, (I use bone beads), fit the beads to the body by grinding. Leave about 1/8" of the rod protruding from each leg. With the scope lying with the legs up, I flux and put a drop of solder on each leg. I make sure the brass rod gets hot enough to let a little solder fill the gap between the rod and the bead. This will hold the bead in place as you make the little ball on the bottom. To make the little balls of solder at the end of each leg, I set the scope on pieces of plain smooth glass large enough to span across both legs with an inch or so extra on both sides. You want your iron pretty hot at this point, with a Q-tip place a drop of flux about the size of a dime, under each front leg. Pick up a drop of solder with the tip of the iron and touch the bottom of the leg rod, if it is hot enough, when you pull the iron away it will leave a nice round ball on the end of the leg. If the ball is too small, add more solder until it is large enough, keeping the glass under the ball wet with flux. With the body sitting level side to side, place the solder ball on the other front leg. Repeat the process for the rear legs. As you finish the last leg, make sure the other three are on the glass. This will fill any irregularities.

The Wheel:

Build the wheel of your choice. The radius of the wheel must be at least the distance from the axle to the lower right corner of the triangle. See the arrows in the diagram above. Double the radius measurement for the diameter of the glass discs. I use clear window glass (float glass) and I drill a hole large enough for the hub to go through the glass. I use a 1/8" glass drill bit and then ream the hole with a diamond coated bit until the hub will pass through. You will need two of these. I drew a circle on cardboard with a compass and cut it out. This is what I use to make my glass disc round.

Once the holes are drilled, lay the cardboard disc centered on the drilled hole and mark the circumference with a sharpie. Cut out the circles with a glass cutter leaving the lines. Using a section of the 1/8" (i.d.) brass tubing as an axle, find a hole in the grid on your grinder top that will take off just a little glass at the shortest radius on your disc. I have yet to cut one that is perfectly round. Using the tube as an axle, grind all the way around the disc. Repeat on the second disc and you should have two good round discs with the hole in the center. Foil the discs and tin the foil inside, edge and outside, clean. To make the hub, I cut a piece of the 1/8" (i.d.) tube a couple of inches long.

In the center of the tube, I spiral wrap with 20 Ga copper wire about 5/16" wide, making sure it is about in the center. I flux and tin the wire, just enough that it soaks into the wire wraps and attaches to the tube. This spaces the glass discs apart. I use 3/8" wide brass strip, bought at the hardware store in a 12" length. I wrap this around a piece of 1" dowel, anything round will do, this curves the brass strip tight enough to fit the discs. At this point I like to place my two glass disc flat together with the brass tube in the holes check to make sure the glass discs match. If not, rotate them a little to see if you can find a match. On the outside of each disc I make a dot with a sharpie. Place the hub with the wire spiral in between the two discs, make sure the inside of the glass is clean, line up the two sharpie dots, place your brass ring around the two discs and space the glass where about ½ the glass thickness is under the brass strip. Dip and blot a Q-tip like we did for the end caps and tack solder the brass strips near one end. I hold the wheel setup with a towel because it gets hot quick. Work your way around the wheel, spacing and tacking the brass strip in place. Stop about 1 ½" from the other end. At this point you can place your wheel on a piece of rod to see how straight it is. If I am satisfied with the straightness, I go ahead and seal the wheel. Leaving the last 1 ½" unsoldered. Now it is time to fill your wheel, I like glass chips cut from cathedral glass but you can use anything you want. I use a mosaic cutter to cut small glass chips of various colors, sizes and shapes. Usually they need to be small enough to move in the wheel. A few long skinny ones are cool also. Once your wheel is 90% to 95% full, tape the opening closed and slip it on the axle and see if you like it. Make changes now if you like. You will have to dress the threads on the axle with flat file in order for the hub to slide on. If you like what you have remove the tape and finish soldering up the wheel. Decide what you are going to use for the end nut. I have used brass lamp finials and brass balls like you see on outdoor light fixtures. Any lamp parts store will have a variety of choices, just remember the threads are 6-32.

Now it is time to clean, patinate or leave silver. ***Remember NO water.*** If you foul the inside you get to take it apart and clean up and start over.