Doming Silver Beads

Step-By-Step Instructions for Making Your Own Silver Beads

by

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Thanks go to my daughter, Karin, and my sister, Lois Phillips. Both are scientists and artists with some metal working experience. Karin encouraged me to write the manual and urged me to provide more graphics to illustrate text. Lois, who also encouraged me to write the manual, edited the text line-by-line, identifying errors, format issues and content accuracy. If errors remain, it is only because I somehow missed recording the changes through the multiple drafts.

Also, I want to thank Lynn Fieldhouse, Art Metal Instructor at the Madison Area Technical College for providing the fundamentals of metalworking. If I have deviated from best practice, this manual only reflects how well the student listens and not on the quality of the information provided. I especially appreciate the creative and vibrant classroom environment Lynn provides which encourages me to explore personal artistic interests.

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Preface

What could be simpler than a strand of silver beads? Round metal beads in gold, silver, copper and brass are found in every ancient culture around the world: ancient Egypt and the Near East, India, Africa, Asia, North-Central-South Americas. The classic globe shape has a natural simplicity of form and universal appeal in many materials: metal, clay, stone, glass, seeds, bone, resins, shells and pearls. Round metal beads can be found in most cultures as adornment for both men and women.

In the Americas, the round silver bead alone is a complete necklace only in some Native American and Mexican jewelry. For the most part, in North America today, the silver bead only serves in a decorative supportive role as spacers or accent beads, with the glass, stone, clay or organic materials holding center stage. In our current culture if you add even one stone, jade for example, to a silver bead necklace, the necklace becomes a "jade" necklace rather than a silver bead necklace with a jade accent.

In Navajo jewelry where vintage photos show men displaying many silver necklaces, much attention is drawn to the squash blossom beads, even though in many instances, there are long strands of small plain silver beads as well. I began to see these plain, unadorned but stunning silver beads in photos from many different cultures. They were there, but in the background, because the authors had something else in mind to emphasize – the time in history, the clothing, the culture, the spectacular centerpiece of jewelry, etc. The humble round silver bead strands, no matter how prominent, received no mention. This was the necklace I wanted.

I have frequently used manufactured beads as accent beads for stone jewelry. Perfect as they are, these silver beads seem stark and lifeless when alone on a strand. When I began taking art metal classes several years back, all I wanted was a really wonderful strand of silver beads.

Well, exactly how hard would it be to make a strand of silver beads? I knew that I needed to learn the fundamentals of metal working to get 90% there, but what I didn't anticipate is that the remaining 10% on doming and soldering processes were not so obvious. My first semester goal was one bead. Actually, I made three beads. Several weeks later, I had completed three necklaces, 60 beads each. During that first semester, I searched every jewelry-making book that I could find for more help on doming and constructing round beads. Almost every book lists dapping punches and die blocks as standard jewelry workshop equipment. Many books said enough to convince me that the authors know how to dome beads, or at least they know how others construct beads, but the details I needed were missing.

This manual is intended as a practical guide to making domed beads for those of you who already have some basic knowledge of metalworking. I included as much detail as I can, not because you need all of it, but because I can't be sure where you need the process to be specific. This is the book that I wanted to find when I was looking for help.

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1
Introduction

This manual follows a series of steps to construct a silver bead within certain parameters. The bead is to (a) be silver, (b) have two holes, suitable for stringing, (c) be within 7.5 mm to 18 mm in diameter, (d) be formed from 24-gauge metal, and (e) be spherical (domed with a dapping punch and die block).

The flow chart below shows bead making from a metal sheet to the final polished bead.

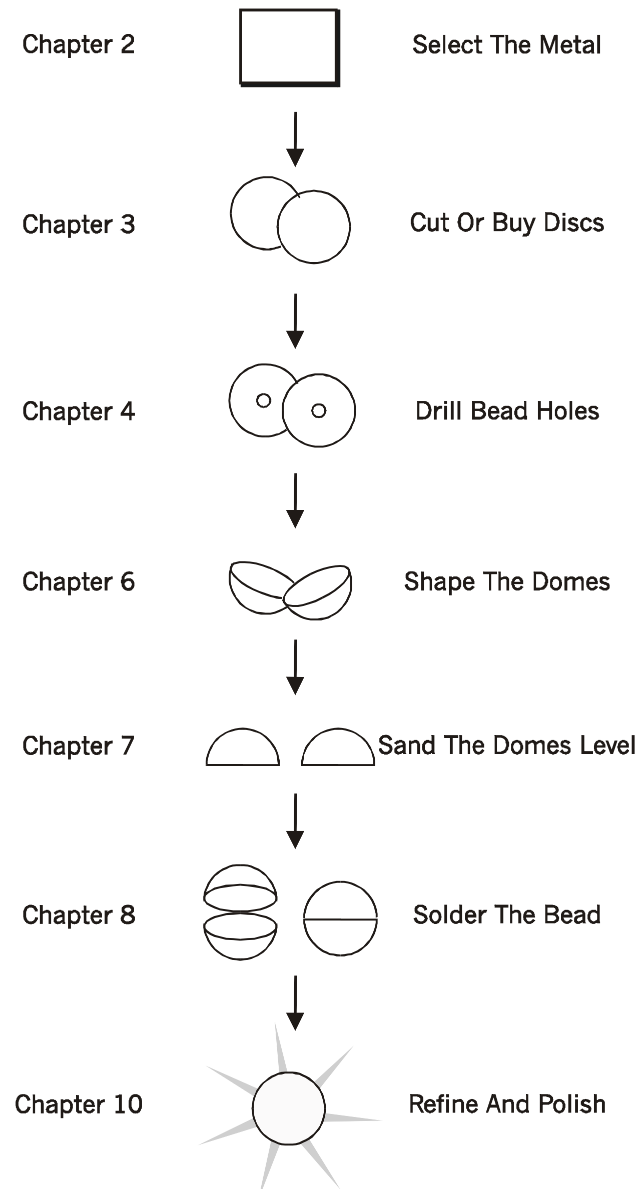

Fig. 1.1

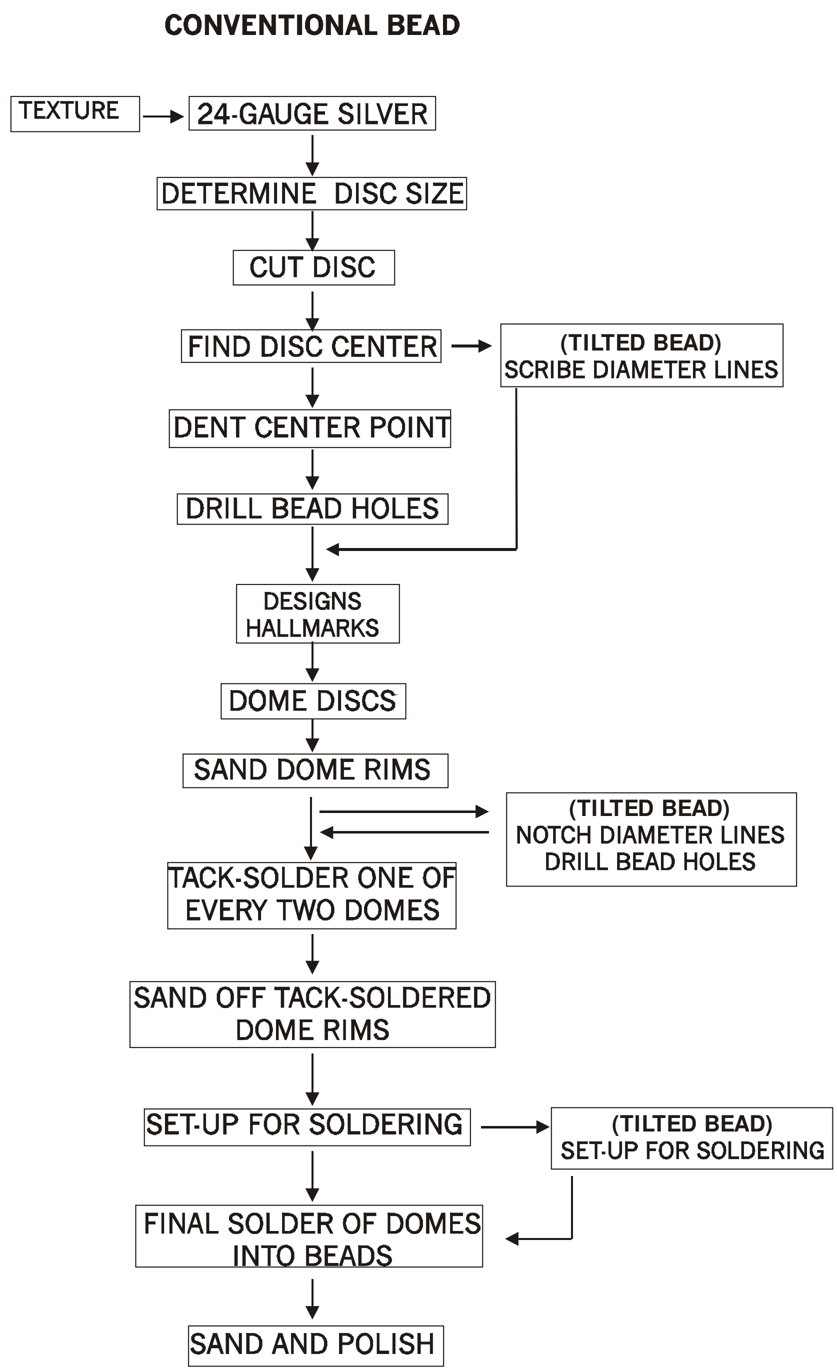

Fig.1.2. Task Analysis of Bead Making

Following the steps in this book, you will start with a ½" silver disc, and finish with a 3/8" silver bead. As you make the 3/8" silver bead you can observe and experience the techniques and principles involved and then apply this information to any other size or shape bead. Even when the techniques are this standardized, your 3/8" beads will express your personality and be different from anyone else's work.

Some specific features are:

1. **Size and Style of the Bead**. Options are included in **Chapters 2 and 11**. **Chapter 3** is based on using a ½" disc to achieve a 3/8" spherical bead.

2. **Bead Holes.** When, where, what size, how to locate and how to drill bead holes are covered for conventional beads in **Chapter 4** and for tilted beads in **Chapter 9**.

3. **Designs or Textures. Chapter 5** includes information on any designs or surface textures you may wish to include and at what point in the process to include them.

4. **How to Dome the Discs** (**Chapter 6**). I use a punch smaller than the die size so that only the center of the disc is punched to the bottom of each die until the goal size is reached. Then the dome is rounded out with a full size punch.

5. **Method of Soldering (Chapter 8**). I use butt joint soldering and hold the domes in position by gravity and flux rather than by the use of binding wire or clamps. This method is extended to tilted beads in **Chapter 9**.

6. **Refining and Polishing the Soldered Bead (Chapters 7 and 10).** Included in these chapters are ways to hold the dome or bead, sanding techniques, and the use of various grits of sandpaper to refine the bead to a high polish.

7. **Other Bead Sizes (Chapter 11).** This manual uses the 3/8" (9.5 mm) bead as its model. This chapter gives information to expand your bead selection from 7.5 mm to 18 mm in diameter. Methods are provided for calculating the size of the disc needed to determine the size of the bead. Also included are the actual sizes of beads that I made from ten commonly available pre-cut disc sizes.

Appendix A is an **Annotated Bibliography** with information on resources that are directly related to bead making. **Appendix B** includes Plan Sheets for recording the steps when doming other size beads, so that your methods can be replicated. **Appendix C** lists tools, supplies and suppliers specific to bead making.

2
Bead Types, Sizes, and Metal Gauge

This manual covers domed sterling silver beads. Domed shapes include everything from a saucer shape to a globe, elongated, or flattened spheroid (**Fig. 2.1**). In addition, there are endless variations where domed shapes can be combined with other forms (e.g., domed shapes on each end of a cylinder), and numerous ways to alter the basic spherical shape with ornamentation.

Techniques covered here include those that make use of a dapping punch and die block. The beads are about 3/4" in diameter or less and are suitable for an all silver bead necklace (same size or graduated) or mixed with other beads made of glass, stone or other mixed media.

A. Bead Sizes, Types

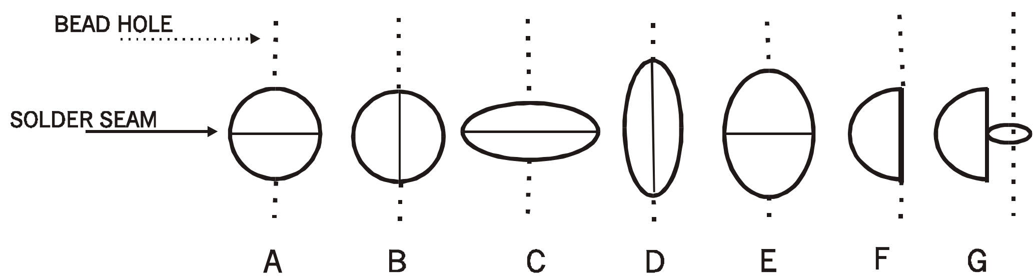

Fig. 2.1. Types of Domed Bead Shapes. Dotted lines show the direction of the bead holes and thin lines show the location of the solder seam. The solder seam is the circumference that locates the diameter. **A** is a conventional sphere with the solder line through the center. **B** is a tilted sphere where the bead hole is on the solder line. **C** & **D** are partially domed oblate spheroids. **E** is a prolate spheroid where the dome is higher than the diameter. **F** is a half-sphere with a flat back; and, **G** is a half-sphere with an attached ring (e.g., button or cuff link).

To illustrate bead-making techniques, I have selected the ½" disc. When domed to a sphere, this disc size makes a 3/8" (9.5 mm) bead. The 3/8" diameter bead, at 24-gauge thickness, fits conveniently inside the dapping block die impressions. The ½" disc provides a workable size for learning various stages of bead development. Issues relating to the other bead sizes are addressed as well in **Chapter 11**.

B. Silver Metal Gauge for Beads

Several square inches of 24-gauge sterling silver sheet, or a number of purchased pre-cut discs, are needed for this project.

Twenty-four gauge (24-gauge) is a good metal thickness for a variety of reasons:

- Commercial beads in final form, are a uniform 28-gauge but they use mechanical processes to form (some are not soldered), harden and polish that you cannot duplicate with your handcrafted beads. Your beads also may end up being 26-gauge or thinner. The doming process you use will compress, stretch and thin the metal as much as two gauges smaller, depending on the number and force of hammer blows. I find that the dome rim becomes slightly thicker than 24-gauge, but the metal gradually thins to about 26-gauge at the center (see **Fig. 6.4**). And, your beads will not be as hardened as a commercial bead, so if you start out with a gauge thinner than 24-gauge, it can become so thin that it is likely to dent if (when) dropped. A 24-gauge bead, after soldering (if air-cooled), will bounce off the floor without denting. In addition to doming, hand sanding and polishing also take its toll on the gauge thickness, but 24-gauge can be reduced in these ways without significant loss of structure.

- Thicker gauges of metal produce a bead that seems too heavy to me, that reminds me more of a ball bearing than a bead for jewelry. A necklace of heavy and/or larger beads is not comfortable to wear. If you are making a bead that is larger than one inch in diameter, a gauge thicker than 24-gauge may be needed. Conversely, if you are making beads smaller than 3/8" in diameter, 24-gauge can be too thick.

  Beads made from discs larger than 1" in diameter exceed the maximum size of the typical dapping block, and also require knowledge of forming techniques that are beyond the scope of this book. However, even with discs in the 3/8" to 1" size, some knowledge of the properties of metals is helpful. You are constructing "very tiny" silver bowls with (relatively speaking) a very big hammer (the doming punch). Ways in which this information comes into play are discussed in **Chapter 6** on Doming.

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3

Cut Discs

You will be cutting the silver to make a minimum of two ½” diameter discs to construct one 3/8” (9.5 mm) silver bead. One 22” silver bead necklace uses about 60 beads; so more than 120 circles will be needed. I find that I always need more discs than I plan to use because of inevitable attrition at later stages of development. For now, start with 4 to 6 discs.

Whichever method you choose (cutting or buying pre-cut discs) bear in mind that the goal is to end up with a nearly perfect round disc. If your circle is off by much, you will not succeed in finding the drill hole center. In turn, the bead holes will not be nicely centered on the dome halves; or, the two halves will not meet together close enough to solder. Each step is important; next steps will compound problems not solved earlier. However, the arid regularity of machine precision is not the goal of handcraft methods. Paradoxically, these minor deviations become the “indefinable” charm and beauty of your handcrafted bead strands.

The following methods may be used to cut discs:

Option 1 **Saw Circles**. Use a steel divider (similar to a pencil compass, but with two steel points) to measure a ½” diameter circle. The steel divider marks the center point and the outer steel point scratch marks the perimeter. Alternatively, you could use a “circles” template to scribe a circle on the metal. If you find the scribe lines difficult to follow, coat the metal with permanent black ink before scribing. The ink can be buffed off or left on because it will “disappear” later in the process when the metal is heated. Saw slightly outside of the scratched line and file to the line for maximum accuracy. Sand off edge irregularities or burrs. Stack one disc on top of the other to verify that the two pieces match.

This sawing method works best if you only plan to make a few beads and/or if you are using a textured sheet metal or combination metals where your only choice is to cut your own discs (**Chapter 5**). The steel dividers mark the center point so the task of “finding the center” is not an issue when it is time to drill the bead holes.

You will generate a fair amount of scrap by cutting out your own circles because the spaces in between each cutout can be reused for little else but casting. Suppliers will accept scrap silver for recycling at up to 70% of your cost; however, it takes some time to collect enough silver scrap to be worth recycling (after mailing costs).

Option 2 **Disc Cutters** are available for punching out various size circles; however, even more waste is generated by this method because you cannot space the circles as close as you can by using a steel dividers/saw method. Anneal the metal before you cut.

If you use this method, select a heavy metal mallet and practice first on 24-gauge copper scrap to get a feel for the force needed to produce a clean cut. If you do not hammer the punch as firmly as needed the first time, the metal bounces inside the cutting plates with the first stroke and double punches the final cut. The resulting double punch crease cannot be sanded out and the disc must be discarded (recycled). If the cutters are not sharp, the resulting edges are ragged and need to be sanded. The cutting punch can become dulled or damaged if you are not watchful about which is the cutting and which is the punching end of the tool – the punch end is beveled. Sanding can change the final circumference of the circle just enough to make a good match of the two dome halves more difficult.

Option 3 **Hand-held Arc Hole Punches**, similar to the punches used for leather belts, are available in various sizes for "light" metals. On 24-gauge annealed metal, the most I have been able to do is stamp on a circular line; however, these cutters may be usable on thinner gauges. A stamped line, however, can be useful as a guide for sawing. Use heavy sheet brass or copper for a pounding block to protect the cutter edge. You might be able to hammer the punch with sufficient force to cut through 24-gauge metal. Anneal the metal before you cut. The Arc Hole punch is less expensive than the Disc Cutter in **Option 2**, and the amount of metal scrap is the same as sawing, in **Option 1**.

Option 4 **Pre-cut Discs**. If you plan to make 5 or more beads, ***I recommend purchasing pre-cut discs***. The slightly higher cost of pre-cut circles is more than offset by the time you save and by less metal waste than occurs with the saw or punch methods. Suppliers (**Appendix C**) offer a variety of pre-cut or custom sizes. With a 3-day mail order turn-around, you will receive the discs you need faster than you can hand cut and prepare.

Pre-cut discs are also useful for parts of other jewelry projects, such as a base for bezels, half-dome earrings or bracelets.

At additional cost, you can purchase pre-cut circles with center holes (i.e., washers with a small center) and even already domed, if you like, but you need to decide where to draw the line. If your role is limited to soldering pre-made domes together, you need to consider whether enough of your self is in the work to justify this considerable personal effort over simply purchasing the more cost-effective manufactured beads

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4
Bead Holes

The bead holes are necessary so that the final bead can be threaded on a string or wire. This chapter includes options on where, when and how the beads are pierced. You may, however, be interested in making a half-sphere button or a single drill ball that will be attached by additional soldering later (or by glue in the manner used for pearls). In these instances, if the sphere or dome is closed, you need only a very small air hole.

A. Safety

Every closed sphere (or other domed shapes) that you construct ***must have at least one air hole before you solder***. It's a matter of personal safety; your bead can explode like hot popcorn if there is no way for air to escape especially if reheated for a second solder or for melting down scrap for casting. With thinner gauges, the sphere can collapse. If neither of these catastrophes happens, your two domed discs can stick together by vacuum pressure alone; then, your bead appears to be soldered but falls open later when enough air is pulled in along the seams or when you attempt to drill holes.

B. Type and Location of Bead Holes

You need to decide whether your bead:

1. Is a **conventional domed bead** where the bead holes are at the north and south poles and the solder join is at the equator. The solder join is used as a reference point to discuss the bead in terms of flattened (oblate) or high (prolate) domes.

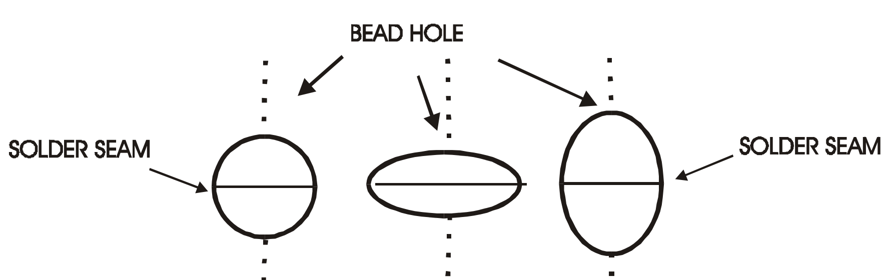

Fig. 4.1. Conventional Domed Bead. The bead holes are at the top to bottom and the solder line is through the middle.

2. Is a **tilted bead** where the bead holes are located on the solder join (the "equator").

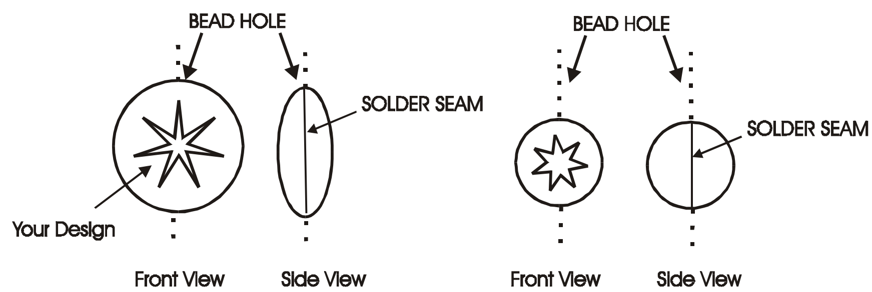

Fig. 4.2. Tilted Domed Bead. The bead holes are located on the solder line. The bead on the left is a partially domed oblate spheroid bead. The bead on the right is a full sphere. Designs can be included on both the front and the back "faces" of the bead.

If the holes are drilled on the solder line, the processes of aligning the holes, drilling and soldering are more complicated. There are, however, a number of times when solder-line bead holes are desirable:

- You want a design on the "face," both front and back of a bead, with the solder seam along the sides,
- You want a saucer shape rather than a spherical shape bead and you want the widest part of the "face" to show,
- Your bead has one domed side and one flat side and you want the domed side to face out (e.g., raised dome buttons).

If you elect to drill holes on the solder line, read through the remaining of this chapter and the next chapters until you reach **Chapter 9** on **Making Tilted Beads.**

C. When to Drill the Center Hole

The following options can be considered.

Option 1 Drilling the Hole on the Flat Disc before Doming. If you are careful at each step – cutting, drilling, doming and soldering – the bead holes will line up better this way than by other methods. For the 3/8" diameter bead used to illustrate techniques in this book, ***I recommend this option***.

Option 2 **Drilling the Bead Holes after Doming but before Soldering.** The presumption here is that doming warps the location of the center holes, but you can control the doming process so that your bead holes stay centered. Also, it can be difficult to accurately measure the center of a dome and dent a drill starter hole on a round surface. Coles[2], **Appendix A**, suggests one useful method. Degree of difficulty is an issue only if you plan to make a significant number of beads. **Re-drill** the holes at this stage, if you want a final hole size larger than 1 mm.

Option 3 **a) Drilling One Hole before Soldering and Drilling the Second Hole Afterwards**. In my experience you can be just as far off center with this method as with drilling the holes before doming. The drill bit shanks in small (e.g., #60 and #68) sizes, typically 1.25", are not long enough to go through the top hole and reach the other end. Drill bit shanks of 1.75" are available but you need to ask for the shank size because this information usually is not included in catalog information. ***I do not recommend this option*** because it is incompatible with the soldering board arrangements that I use (see **Figs. 8.2 and 9.2**), which require two bead holes.

b) Drilling both of the Bead Holes after Soldering. The practice of soldering a closed sphere with no air hole is dangerous, and no responsible metalsmith recommends this action. Several authors have harrowing stories to tell about exploding spheres. ***Do not plan to drill both bead holes after soldering.***

D. Finding the Center

You must dimple or dent the place on the disc where you want to drill a hole. If you do not dimple a starter point on the metal, the drill bit will not hold in place long enough to grip the surface – the drill bit will skitter across the surface and bend or break. When using a very small drill bit (e.g., #68), the bit may pierce the metal without a starting dent, but rarely where you planned.

Whatever method you use to locate and dimple the center point, placement of the hole at dead center adds to the overall quality and appearance of your final bead strand. As illustrated below, if the bead holes are off-center, your bead strand will be out of balance. If the hole is noticeably off-center, toss the disc in your recycle bin. You have a "fatal error." No matter how well done your bead may be from this point on, it will not compensate for the effects of off-center holes.

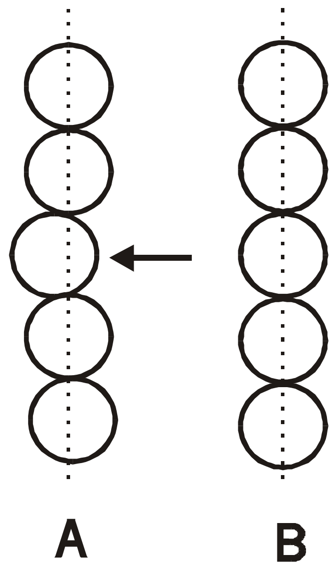

Fig. 4.3. Effect of Location of Holes on Bead. **A** is a strand of beads with bead holes that are not centered (arrow on middle bead). **B** is a correct bead strand where each sphere is centered on the strand.

Option 1 Dividers

If you used steel dividers to measure and cut discs, the center point is already marked by the tool. Use a “nail starter” punch (available at hardware stores) or a “center punch (available from jewelry tool suppliers), to dimple the center point.

Option 2 Circles Template

A “circles” template (RAPIDESIGN® R-40 plastic template) can be used in that the “cross hair” marks are stamped on the edge of each circle. Draw a line across the “left-right” marks and the “top-bottom” marks. You can draw directly on the disc in pencil for these temporary lines. The “circles” template is a somewhat imprecise method, so you may need to double-check the lines by rotating the template and redrawing the lines. Use a scribe to tap a mark at the center, followed by the center punch to complete the dimple.

Option 3 Multi-Use Rule & Gauge

The Multi-Use Rule & Gauge by General® (No. 16me, UPC 22015) includes a circle center finder. The disc is wedged against a “v” on the ruler and a movable arm swings into place to locate the diameter. Mark the diameter with a pencil, rotate the disc and draw a second line to locate the center point. The movable arm is riveted down and the rivet's height is enough to cause the disc to slide underneath the ruler. Elevate the ruler between two plates (metal, wood) on both sides of the rivet so that the disc can be level with the measuring edge. It is difficult to verify that the disc is in position because the movable arm blocks the view on ½" or smaller discs. Overall, this gauge seems more accurate and easier to use than a "circles" template.

Option 4 Make Your Own Template

With a piece of stiff clear plastic (see **Appendix C**), use your steel dividers to scratch a ½" diameter circle on the surface **(Fig. 4.4).** Drill a small hole through the plastic at the center point. With a second piece of plastic, preferably in some color, use your dividers to scratch a second circle that is the correct size to fit over the ½" disc (a slight amount larger than your first circle). Instead of just scratching the surface on the second plastic, continue turning the dividers until you have cut a hole through the plastic. Align the first piece of plastic over the second cutout and tape the two together. Use a permanent ink pen to identify the size. This template should fit over your disc and hold it in place so that you can use a center punch to dimple the metal. This method is much faster than the circles template or the circles center finder gauge, especially for center-punching multiple discs.

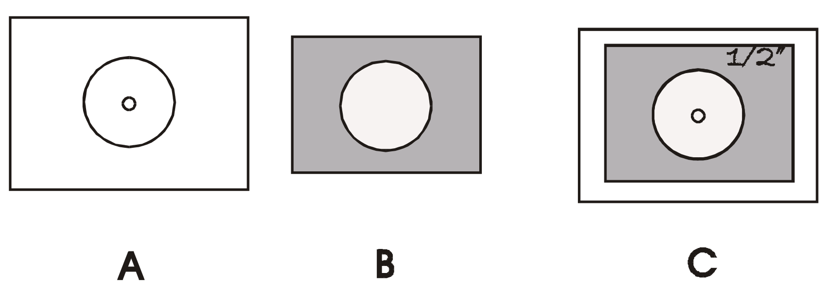

Fig. 4.4. Template for Punching the Disc Center. A is a ½" diameter circle scratched on the surface of a piece of clear plastic, with a hole drilled through the center. **B** is a slightly larger ½" diameter circle scratched through to make a hole in a colored piece of plastic. In **C**, the clear plastic is placed over the second, colored plastic hole and taped together. Place your disc under the template and, using the center hole as a guide, use a center hole punch to dimple the metal.

E. Size of Hole Drilled on the Flat Disc before Doming

- Cut a small hole even if you want a larger one in the final bead. I use a drill bit size #68. A #68 drill bit makes a hole that is about the size of 20-gauge wire. During doming, this size hole will stretch to about the size of 18-gauge wire, or about one millimeter in diameter. If the drill hole is too small, you likely will dome it shut and will need to reopen the hole before soldering. If the hole is much larger than 20-gauge, the size of the hole will stretch to larger and uneven sizes when you dome it. The **Fig. 4.5** chart converts standard drill bit sizes to wire gauges.

Drill Size	Wire Gauge
#52	14
#55	16
#60	18
#68	20
#72	22

Fig. 4.5. Drill Bit Size & Equivalent Wire Gauge. Standard drill sizes and their equivalent wire gauge sizes. Use a #68 drill bit so that, after doming, the final hole size will be 18-gauge, or about 1 mm.

- Drill or file the hole larger after soldering, but before you do, consider the advantages of having a small hole. (Some disadvantages will be mentioned later, in **Chapter 8, Soldering**.) With small holes, you can make a necklace out of all silver beads where most of the round bead shape will be visible, similar to a string of pearls (**Fig. 4.6B**). If the holes are too large the beads will appear “stacked” one on top of another (see **Fig. 4.6A**). However, if you plan to string the beads on leather or thick cord, a larger bead hole is needed.

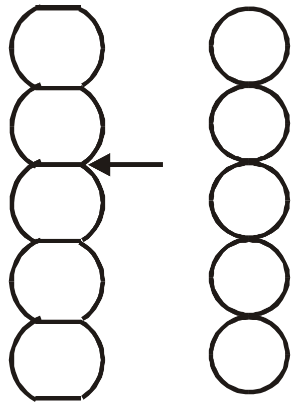

Fig. 4.6. Effect of Size of Bead Hole. Strand **A** has holes that are too large; the beads appear stacked one on top of the other. **B** with smaller bead holes, has most of the round bead shape visible.

F. Drilling Methods

Punch or drill the holes as follows:

Option 1 **Punch a hole** with a scriber or a thin nail. If you use this method, take care to only punch a hole smaller than the final size. Make a small dent at the hole location and tap-hammer the scribe or thin nail through the metal. Punctured this way, the scriber/nail essentially tears a hole in the metal; the edges of the hole are ragged and the metal is thinned. Use scrap brass or copper as your pounding block because your scriber must go part way into the pounding block to form the hole in the silver; and, so that the amount of metal stretch next to the hole is minimized. Your scriber will be blunted (ruined) and not able to form a hole if your pounding block is steel, or the metal will dent in too far if you use wood.

Sand off the rough edges and use a bead reamer or round needle file to widen and smooth the hole to the un-thinned inner edges. If you have a slight bulge surrounding the hole, pound the disc flat by placing it between two steel plates and hammering the plates. If you don't file and sand, you will have problems in doming in that a ragged edge will be pressed into the metal and/or a thinned edge tends to crack when doming. Also, a sharp thinned edge will cut whatever bead cord or link you plan to use. As indicated above, ***I recommend a final bead hole size of approximately one-millimeter in diameter***.

Option 2 **Drill a hole** with a "micro" power drill. I use a Dremel®tool with a drill press attachment. Also, a "micro-collet" adapter attachment is helpful for firmly holding such small size drill bits. Make sure the drill bit is perfectly aligned, with no wobble, before you power drill. Use a pine block as the base and hold the disc to the base with the edge of a Popsicle stick so that your fingers are not in harm's way. If the drill bit is worn or not aligned, the metal becomes too hot to hold. If the cutting speed is not fast enough (at least #3 on a Dremel® variable speed drill) the drill bit can catch on the disc and pull the bit out of the collet.

If you do not have a power drill, use a hand drill as a cleaner alternative than punching. Secure the disc to a pine block with double-sided masking tape, or tack down the edges with duct tape.

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5
Design – Stamp, Etch, Texture, Inlay, Combine Metals

Before cutting or doming, you may wish to stamp or etch on designs, roll or punch on textures, inlay or mix together different metals. Doming will only slightly alter your designs. Anneal a copper penny and dome it to see the amount of distortion to expect. Also, consider how much of the design will show when you account for the space needed at the solder line. You might consider placing the bead holes on the solder line so that a design on the bead face will be better displayed. Refer to **Fig. 4.2**. Paint on "white-out", yellow ochre, or whiting pastes on your patterns or texture to prevent the solder from flowing on and covering over your designs.

Light texturing, including sandblasting, also can be added to a finished bead. To add texture, place the finished bead into the correct hole on a doming block lined with chamois to hold the bead steady and tap with a light touch. You may want to apply a texture over the solder line to match the texture on the rest of the bead.

The following are some types of designs you might apply ***prior to doming a disc***:

A. Stamp Designs A variety of metal stamp designs are available from jewelry tool supply catalogs, or you can make your own from steel rod (both square and round) available at hardware stores. You can saw the steel rod with a heavy blade in your jeweler's saw. Saw the rod into 3" – 4" lengths and file on a variety of shapes. You do need oxy-acetylene gas to harden and temper the steel. Weygers[11] suggests that you make a variety of curves, straight lines and other basic shapes to use to compose your own unique designs. Also, McCreight[4] provides information on making your own tools. Practice stamping techniques on scrap copper.

Stamped half-dome buttons can be very interesting. Some Native American crafted beads have stamped designs on buttons and on full bead necklaces. Sometimes only three to five of the center beads have stamped designs on an otherwise plain silver bead necklace.

Hallmarks, such as "sterling" or ".925", your initials, name or logo, ***must be stamped on a flat disc***. Hallmarks or personalized stamps are available through jewelry tool suppliers.

For the best imprint, use a steel block and a heavy metal hammer or mallet. Stamping usually distorts the disc. To restore the original flat shape, place the disc between two smooth steel plates and hit the plates with a heavy hammer. You can purchase lengths of 2" wide steel plate from the hardware store and saw it into 6" lengths to use as pounding plates.

Anneal the stamped disc before doming because the stamped parts are selectively hardened more than the rest of the disc.

B. Texture. You may wish to texture discs either by hammering or metal roller. Rollers (and sometimes hammering) distort disc shapes, so rolled or hammered textures usually need to be done on sheet metal before discs are cut.

C. Cutout Designs. On a 24-gauge disc cutout designs are distorted by doming, and the larger the spaces in the cutout, the greater the distortion.

- Cutout designs can be pierced and domed without much distortion on a domed saucer (oblate) shape.

- To minimize distortion on higher domed discs, you can scribe your design on the disc and dent starter points for drilling, or drill small holes for later inserting the saw blade. After doming, complete the cutout sawing. Expect to break saw blades because it is difficult to saw out a design in a high domed shape.

- For high domed discs, cut out a design on one disc, sweat solder it to another disc and drill saw blade holes. After doming, saw out the backing. The original cutout does not distort and provides an edge to follow for the final cutouts. For beads, use thinner metals for a cutout and backing so that the final bead is not too heavy.

Bear in mind that if you create a cutout design for a sphere, depending on the design, you likely will not be able reach inside the sphere to sand, or polish, etc.

D. Inlay or Combined Metals. File or use a graver to make a groove or channel and solder in a metal wire of copper, brass, gold, etc. Doming will further integrate the metals. If you solder a cutout design or wire on top of the discs, doming will press the metals together in interesting ways. Additions to the top of the disc, however, must be in "low relief" and able to be domed flat at the disc edges or the edges will be crimped; a crimped edge must be domed smooth to be able to solder it to another half-dome. Any design not to be pressed into the dome must be soldered on after the bead is in its final form. Attractive bead designs, added after the final stage of bead making, abound in various cultures most notably India and Bali.

⊙⊙⊙

6
Shaping the Dome

Most, if not all, writers who cover the doming process indicate that you put a flat disc in the correct doming block die, use the punch that fits, progress from larger to smaller die sizes, remove your perfect half-sphere and proceed to sanding and soldering. Anyone observing an expert using dies and punches would conclude that the process is that straightforward.

A typical first try usually finds the process much more complex:

- The disc doesn't fit nicely into a block die, especially when the disc needs to be fitted into just one more die smaller to complete the half-sphere;
- 3, 4, 5 different dapping punches are tried, because none work right. The punch sizes are all mixed together and they roll every which way on or off the work bench;
- The partly domed disc gets creased or gashed across the disc from the edge of the doming die;
- Before you have made much progress, the metal "pings," so you need to stop everything to anneal;
- You return to doming and punch this side and that, but your dome is crooked and curling, and the bead hole is off-center;
- Next, the metal gets stuck in the block die, or worse, gets stuck on the end of the punch; and,
- You finally get one right, but because you tried so many punches and dies, you can't retrace your steps to create a matched mate for the half-sphere.

This chapter outlines the doming process with a ½" disc – which sequence of dapping block dies to use, which punch tools to use, how to hammer, when to anneal. Also included is information on avoiding or correcting the pitfalls listed above.

If you use different punch tools each time, your beads will not match with same size discs domed at a later time and with a different hammering pressure and sequence of tools. If you dome all of the beads you want for your project at the same time, this is usually not an issue. However, for a 60 bead necklace, for example, you might be able to tolerate doming about 10 discs at one sitting; later, about 20 discs at one time – but rarely more than that before fatigue sets in.

You absolutely must write down your own sequence for each size/gauge bead you make. As well, you need notes on the appearance of the bead at certain stages to replicate hammer blows. If my suggested sequence for the 3/8" (24-gauge) bead does not work for you, change it, but write it down. Keep a step-by-step journal, notes on index cards or use the suggested form in **Appendix B**. Pare down unnecessary steps each time you repeat a process so that you can minimize the number of times annealing is needed – and write the change down.

A. Equipment

1. Dapping Blocks

Hardened metal dapping blocks are used with steel dapping punches to form hemispheres. There are no standardized die sizes used by all manufacturers. Most dies are cut to fractions of inches but listed in catalogs in millimeter sizes. The die sizes are not marked on the die block. The half-sphere impressions range in size from 2 mm to 50.8 mm (2") in diameter, with the most common blocks covering the mid-ranges from 4 mm to 25.4 mm (1"). Refer to **Chapter 11, Fig. 11.5** for converting millimeters to fractions of inches.

The most common form for a dapping block is a 2" cube shape of brass or steel in which various half-sphere machined impressions, called "dies" are located.

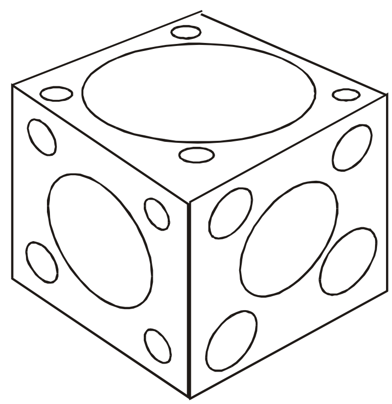


Fig. 6.1. Cube Dapping Block

Regardless of the size bead you are making, you will need to go back and forth between the dies: back to correct, forward to progress, from larger/flatter to smaller/higher domed. Cube blocks are designed to use as much of the space as possible on all 6 sides so small die sizes are mixed on the same side as larger sizes. See **Appendix B** for an example of the dies on all six sides. This means that to move in sequence, you need to turn the cube as you change sizes. If you only have a cube block available, tape numbers next to the holes you will be using.

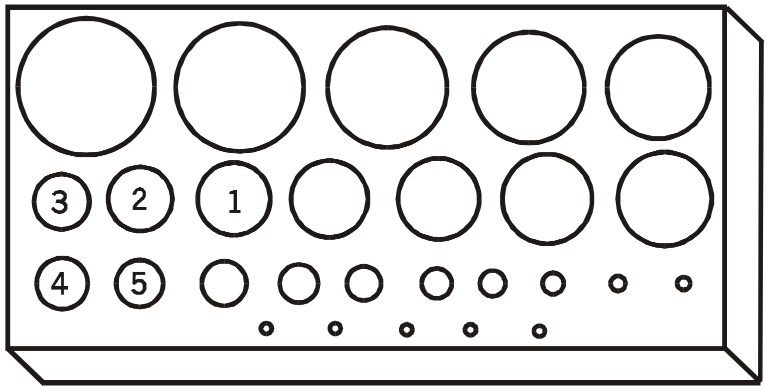


Fig. 6.2. Flat Steel Dapping Block. The flat rectangular steel block offers a distinct advantage over a cube block. The die impressions are on the top surface only and are arranged in sequence from large to small. The numbers 1-5 represent the sequence of dies needed to dome a ½" disc.

The flat, rectangular block offers a distinct advantage; the die impressions are located on the top surface only, from the smallest to largest dies in sequence. If you plan to purchase a dapping block, ***I highly recommend a flat block similar to the block illustrated in Fig. 6.2***. For the dimensions of the dapping block dies in **Fig. 6.2**, see **Fig. 11.6**. You may only be able to approximate the die sizes I suggest.

At this point, bear in mind that generally, the punches and die blocks allow you to work any size sphere as large as 1" in diameter down to too small to consider (2 mm). Sizes that fit the punch head, but not the block die, require different strategies and will be addressed at the end of this Section.

2. Punches

Hardened steel dapping punches are cylindrical rods with a spherical shape on the end. These spherical shapes range from 2 mm to 54 mm in diameter. The 24-piece punch set I use ranges from 2.5 mm to 20 mm. Punch sizes between 6 mm and 14 mm are the most frequently used. Individual punches can be purchased as "replacements" from most manufacturers, but buy a whole set so that you will be able to create a variety of bead sizes. The diameter of the spherical end of the punch always is stamped in millimeters on the shank.

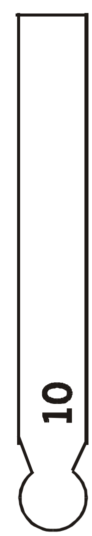


Fig. 6.3. Punch

3. Care and Maintenance

Your expensive punches and die block must be maintained in perfect condition. Any scratches or irregularities on the tools will be stamped onto your disc. Keep these tools oiled, if rust is a problem, and store them in numbered order. Wooden stands for punches are beginning to show up on the market, or, you can make your own punch stand out of a block of wood with various size holes drilled to hold the punches upright. Or, you can line a small box with corrugated cardboard – anything that will keep the punches in order, by size, and prevent them from rolling around.

Resist the temptation to use these tools for other silver projects, such as chasing, hammering, and so forth, because any damage to these tools will render them useless for bead making. Buy a small set of punches to devote to those other projects.

4. Mallet – Type and Force

Use a mallet of sufficient size and heft so that when you strike the punch about ***one to three times***, you can move to the next die size in descending order.

Use a 1.5" face rawhide mallet for several reasons:

- The face is large enough so that you can concentrate on your work piece rather than on aiming the mallet to the punch;
- You use the weight of the mallet (rather than your arm muscles) for much of the force needed;
- Leather does not mar the surfaces of your tools; and,
- The hammering sound is less jolting on you and others.

Anneal before you start, if need be, but precut discs and most sheet metal are at least half-hard and do not need an initial annealing. Anneal once just before you reach the final size (**Step 5**), and, sometimes again to correct shaping problems. Even if you start with annealed metal, you still need to anneal again at **Step 4**. I have tried both annealed and not annealed discs at the beginning and find no difference moving through the first four steps of doming (see **Section C**, this chapter).

Start with the mallet only a few inches above the punch, "one to three strokes – one die impression" is all you need (or, is at least the goal), plus around 4-6 more corrective strokes near or at the final bead size.

If you use a lighter weight hammer and "tap, tap, tap" you will spend a lot of time mostly hardening the metal at each descending order die. As well, if you pound the mallet as if you are hammering a nail with a rebounding hit, you will prematurely harden, distort and thin the metal. Each hammer stroke you make has an effect on the metal and, depending on the number of hammer blows, the metal can be thinned by 1 to 2 gauges (e.g., 24-gauge thinned to 25-gauge or 26-gauge). See **Fig. 6.4**. You need the hammer blow to be a forceful "thud," so you want each blow to have the specific purpose of moving the disc to the base of each die.

Shop around and order a leather mallet through a jewelry tool supply catalog. Mallets sold in leather stores are at such high prices that, if this is your only alternative, consider a weighted plastic mallet instead. A metal mallet or flat-face hammer will, of course, work fine – but will mar your dapping tools and the metal hammer sound over a couple of hours – can be unnerving. Consider wrapping the face of a metal mallet with leather.

B. Doming Principles

When you first begin doming, you will be tempted to use a punch that fits each size die and to push the disc fully down to conform to each descending order die size. Several things happen when you do this:

- The metal quickly becomes hardened.

- The base of the arc is too broad in the larger/flatter die, so the disc edges will not fit into the next smaller/higher die. If you try to make it fit, it can result in creasing the metal face.

- The metal becomes stretched out and the extra metal is pushed high above the die rim. Once you have stretched the metal too much, you either make a bigger, thinner bead or file off the excess. The better alternative is to prevent this from happening.

Because the disc is small and the punches are relatively large, you will find it very difficult to observe the sinking movement of the disc in the die; but, if you keep the following issues in mind, these principles will assist you to dome any size bead.

1. **Conform the disc fully to the die only at the final bead size**. What you are doing up to that moment is keeping the bead hole centered and evenly lowering (sinking) the center of the disc down to the desired spherical shape. Said another way, the die block supports the rim of the dome while you "sink" the center of the dome to the bottom of the die. Once you reach the bottom of the die, stop hammering, because you will only harden the metal against the die block. At that point, the dome is moved to the

next smaller die to repeat the process of "sinking" the dome to the bottom of the die until the goal size die is reached. When the goal size is reached, the areas next to the dome center on up to the rim are punched so that the arc is rounded-out and the dome fully conforms to the die.

- The first punch you use to sink the flat disc to a curve. You select a die that is ***one to two die sizes larger*** than the diameter of your disc;

- The next die is close to the diameter of your disc. The punch, which is ***several millimeters smaller*** than the disc, concentrates the force in the center of the disc. Notice that your disc will have a shiny spot in the center at your point of impact;

- In the next two dies, the punch blow continues to concentrate force in the center, sinking the dome deeper into smaller dies.

2. You are hardening (compressing), stretching and thinning the metal in the center of the dome.

Be aware that during doming the half-spheres gradually thin toward the center. The dome rim thickens slightly but thins to about 26-gauge at the center (**Fig. 6.4**). This thinning is not obvious but the center area is quicker to overheat during soldering.

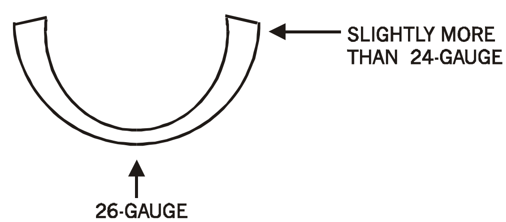


Fig. 6.4. Gradual Thinning of Dome Walls. During doming, the dome rim increases slightly but thins toward the center. This thinner area can be overheated during soldering.

3. When metal is hammered against the depression in the die block, the **central point of impact pushes the metal out equally in all directions**.

4. Because the center of the dome is pushed outward, but bound by the dome's un-hammered edges, the metal in the center has nowhere to expand. The **outward movement of the center of the dome, modified by the curvature of the die and by the dome's un-hammered edge, creates the upward curving movement** on the dome. To demonstrate this, hammer the center of a flat disc on a flat surface; the outer edges will move upward. This progressive upward/inward movement of the disc edges is how you avoid gashing the face of the dome as you move to smaller dies.

You must not interfere with this upward movement at the edges, such as:

- Using a punch that is too close in size to the die size and prematurely hammering the sides of the dome;

- Using a punch that is too small for the disc size so that the hammer impact causes the bottom of the disc to bulge out, instead of stretch evenly outward; and,

- Hammering off-center or anywhere on the edges that you want to continue unimpeded in an upward direction (or downward movement of the center, depending on how you look at it). Now and then, you will need to make corrective strokes, but seriously misplaced punch blows are very difficult and sometimes impossible to undo.

5. Once you reach the goal half-sphere size, you no longer want a downward, stretching motion. Instead, you want an almost **exact size punch to the metal/die size to expand** the (still annealed) sides of the dome to round out the dome to the die.

The final punch tool is slightly smaller (8 mm) than the exact goal size so that you can tilt the punch to tap and stretch the metal from the (hardened) center all around and outward to the top edge.

C. Illustrated Steps to Doming

1. Doming the Disc to the Die Size

Before you place a disc in a die, make absolutely sure that the die is clean and free from any slivers of metal or workshop dust. The smallest speck of foreign matter will be impressed on your disc.

It is easier to do a number of same size domes than to "switch gears" each time with all different sizes. Also, it will not take nearly as much time to dome the disc as it does to read how. Once you know where you are headed and establish your own rhythm, you will find yourself absorbed and completely unaware of time until you finish.

Illustrations of the step-by-step doming process start next, in **Figs. 6.5** through **6.10** below. You will be using the following dapping punch sizes: 6 mm, 7 mm, 8 mm and 9 mm.

Don't get too caught up in the detail with the numbers, your dapping punch and die set may not be exactly the same, and the force of your hammer blows may give you different results. The following illustrations are a general guide of what to expect.

DIE BLOCK

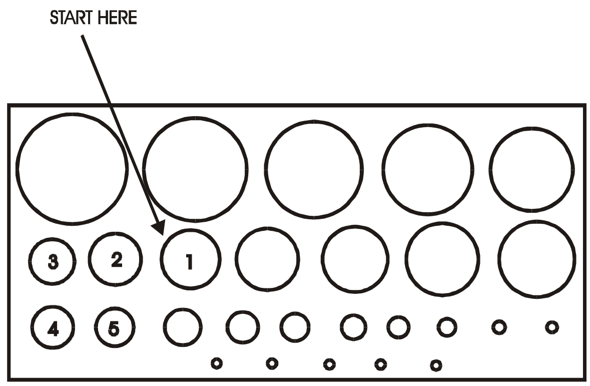


Fig. 6.5A

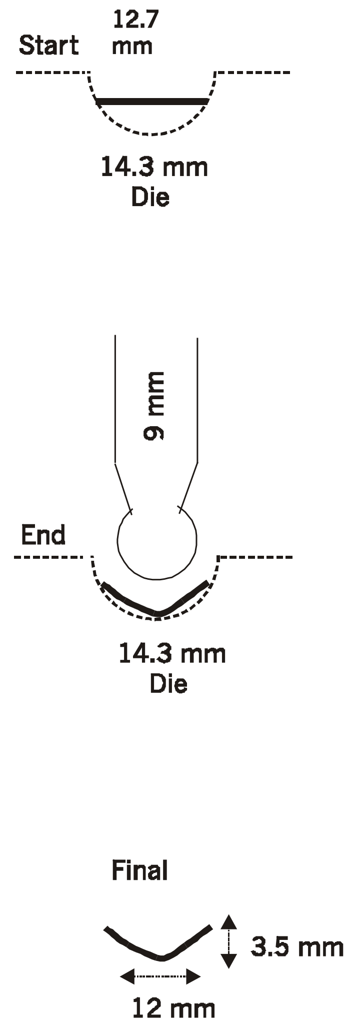


Fig. 6.5B

Step 1 The 9 mm Dapping Punch and Die Block Impression #1.

Punch straight down with a 9 mm dap punch to sink the ½" (12.7 mm) disc center to the bottom of the 14.5 mm die impression marked #1 (**Fig. 6.5A**).

Note that the die is about two millimeters larger than the 12.7 mm disc (**Fig. 6.5B**). You establish the center point over the bead hole (or at the center mark if the bead hole is on the solder line).

The disc is about 3.5 mm below the die rim both before and after doming; only the center of the disc sinks downward and the diameter pulls inward about a millimeter.

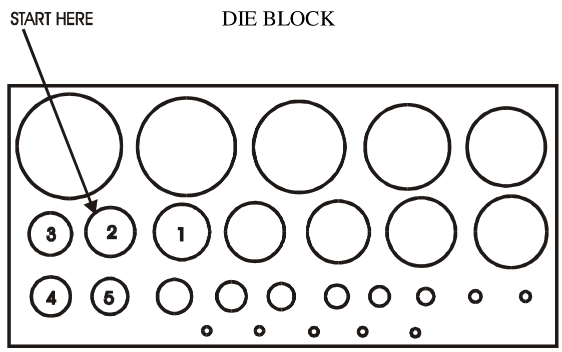
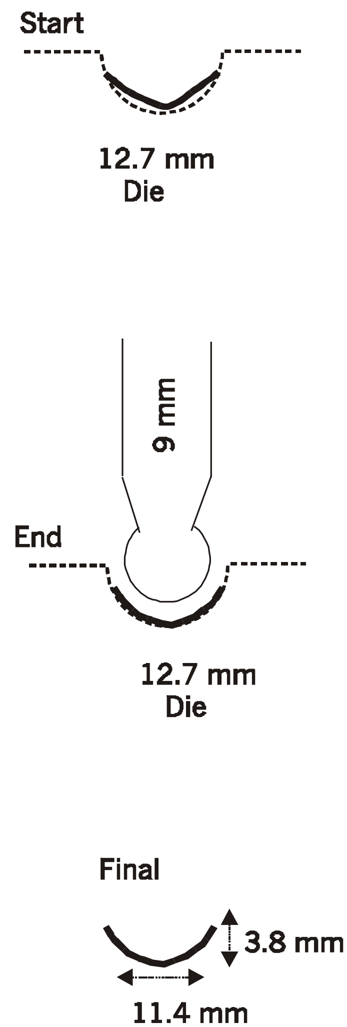


Fig. 6.6A



Step 2 The 9 mm Dapping Punch and Die Impression #2

Punch straight down with the 9 mm dap punch to continue sinking the disc center to the base of the 12.7 mm die impression, marked #2 above (**Fig. 6.6A**).

The disc is about 2 mm below the die rim both before and after doming (**Fig. 6.6B**).

The depth of the dome does not change much but the diameter reduces another 1 mm from **Step 1**.

Fig. 6.6B

DIE BLOCK

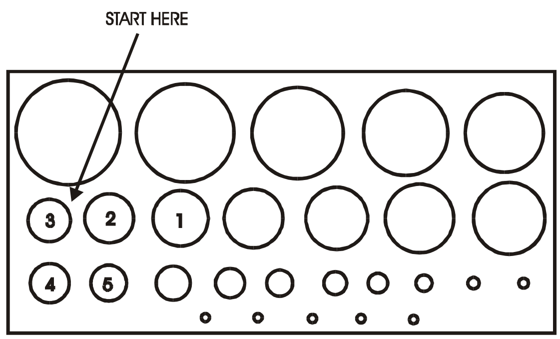


Fig. 6.7A

Step 3 The 7 mm Dapping Punch and Die Block Impression #3.

Change to a 7 mm dap punch.

With the 7 mm punch, stay centered and punch straight down to the base of the 11.1 mm die impression, marked #3 above (**Fig. 6.7A**). The disc will end up about 1 mm below the die rim and the disc diameter is reduced by another millimeter.

This time the disc is about 0.5 mm above and over the rim of the 11.1 mm die (**Fig. 6.7B**). Take care to stay centered with the punch over this disc/die so that the edges of the disc will scrape the rim of the die on its way down, but will not crease the metal. If you are off-center, the larger off-center side is at risk of being creased by the die rim unless you correct the shape. Such mishaps are a normal part of dapping and need to be fixed before moving to next steps; refer to **Section D** on doming corrections.

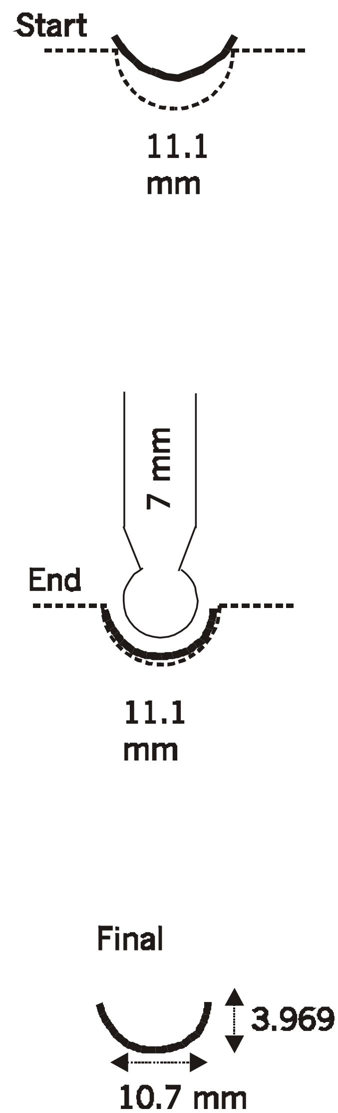


Fig. 6.7B

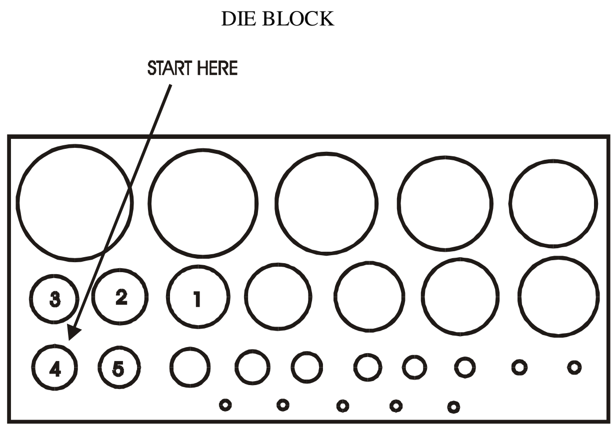


Fig. 6.8A

Step 4 The 7 mm Dapping Punch to the 6 mm Punch, and Die Impression #4.

a. **Stay with the 7 mm punch**. Again, the disc will be slightly above and over the rim of die impression marked #4, above (**Fig. 6.8A**). As with **Step 3**, stay centered over the disc and punch straight down. The disc ends up being close to level with this die. **ANNEAL THE DISC**.

b. After annealing, **change to a 6 mm dap punch**. Place the disc back into die impression #4 (**Fig. 6.8A**). Punch one firm tap straight down on the center mark or bead hole. This action is taken to reestablish the disc center, to slightly pull the diameter inward, and to partially harden the bead hole to prevent the annealed metal from stretching at the hole (**Fig. 6.8B**).

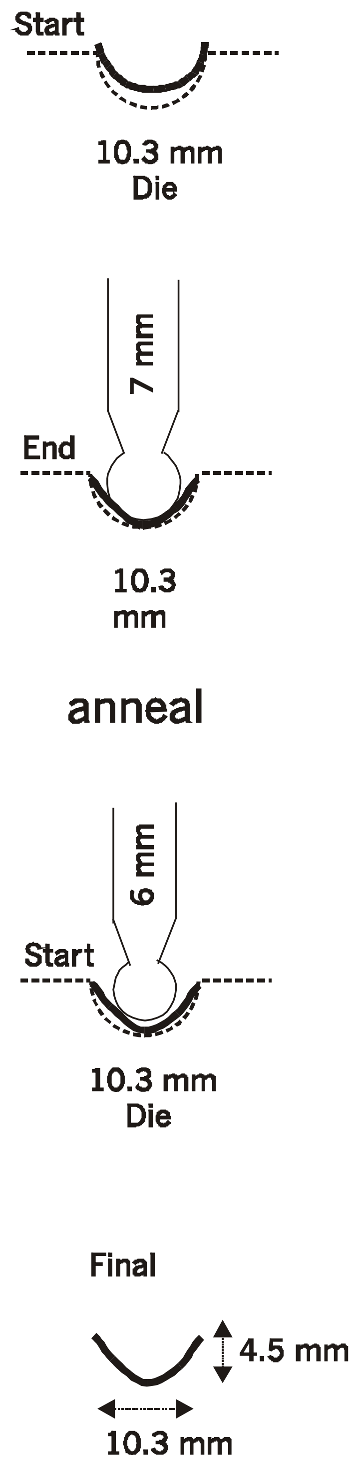


Fig. 6.8B

DIE BLOCK

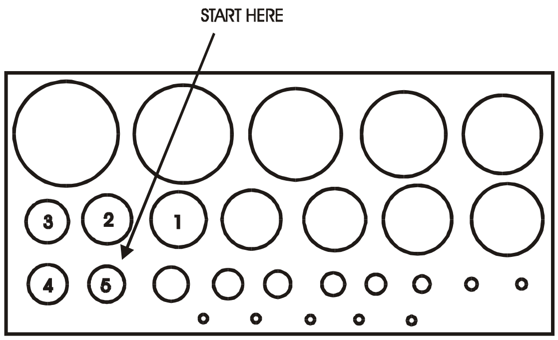


Fig. 6.9A

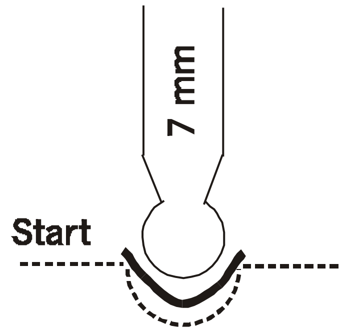


Fig. 6.9B

Step 5 Change Back to the 7 mm Punch and Use Die Impression #5.

As with the two previous steps, the disc is larger than the die, but this time the disc is about 1.5 mm above and over the rim – a much larger overage at die impression #5 (**Fig. 6.9A**).

Measure the diameter of the disc. If the diameter is wider than 10.3 mm or so, consider returning to die impression #4 to reduce the diameter. One way to do this would be to use the 6 mm punch to hammer just above, below, left and right sides **next to the bead hole or disc center point**. The resulting outward and upward movement reduces the diameter, which in turn keeps the slope of the disc sides at least at a 45^{o} angle from the die face.

a. Use the 7 mm punch as the first punch in die #5. Start with a lighter hammer blow to partially move the disc downward, then another hammer blow to about mid-way, then punch straight down to the base of the die (**Fig 6.9B**). If the diameter of the disc is about 10.3 mm, and your hammer blow is on center, the disc edges will scrape inward past the die rim. However, this step is a critical point in doming because it takes some skill to keep the disc centered. (Also, refer to **Section D, Fig. 6.14** if the dome is off-center.) The diameter will be at the correct size, but the disc will not be fully conforming in the half-sphere die impression. The dome will be a “rounded cone” shape.

b. **Change to an 8 mm punch** for the final steps.

First punch straight down with **the 8 mm dap punch** to widen the base of the disc. Then, tilt the disc in the die to punch all around the edges and mid-point to round out the bead (**Fig. 6.10**). If there are any shallow crease marks, firm punching on those lines will minimize the flaws that need to be removed by sanding.

If the **dome is stuck** in the die, corrective actions are presented in **Section D, Fig. 6.15**.

c. **Inspect the dome** to make sure that the half-sphere is well formed. Fit it to another half-sphere to check the final appearance. For shaping problems, refer to **Fig. 6.16**.

d. **The final disc size is 9.5 mm in diameter**. As illustrated in **Fig. 6.11** below, the outside edge of the disc will be about at the rim of the die. The inner edge of the dome will be slightly higher. The final size, in this case, is 9.5 mm in diameter and about 4.9 mm in height. A round sphere measures 4.75 mm for each dome half; therefore, you need to remove 0.15 mm from each dome when you sand the domes flat in preparation for soldering (**Chapter 7).**

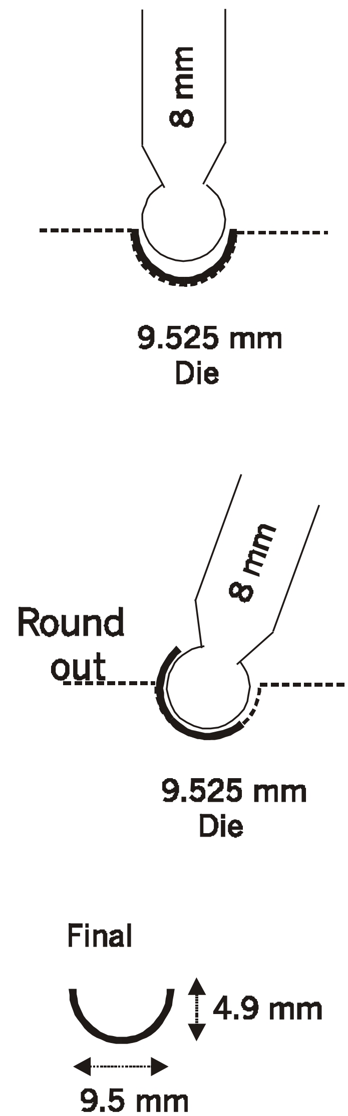


Fig. 6.10

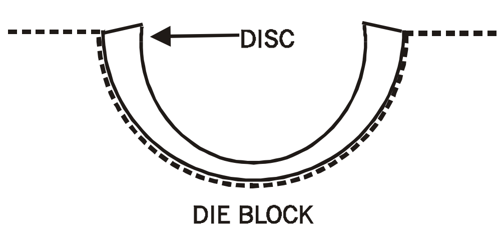


Fig. 6.11. Final Size Dome. Enlarged view of the final dome size. The outer disc edge is even with the rim of the die and the inner disc edge is slightly (0.15 mm) above the die rim.

In summary, through a “sinking” process the flat disc is shaped from flatter/larger to higher/smaller dies by only punching the center of the disc until the final size die is reached. At the last step, the rounded cone shaped dome is tilted and punched to its final round spherical shape. If shaping corrections are needed, see **Section D** below; otherwise, the doming is complete, so proceed to **Chapter 7, Sanding**.

The next section below is only for those who wish to expand bead size choices by using the punch, instead of the die block, as the forming tool.

2. Doming the Disc to the Punch Size

Up to this point, the doming process has been described as a method for forming domes based on conforming to the dapping block die impressions (**Fig. 6.12A**). However, there are times when the exact size you want can best be achieved by conforming the disc to the punch size (**Fig. 6.12B**). You can dap any size, but unless you use the tools as a form for the discs (the die or the punch), you will find it very difficult to match two domes together to make one single bead; the task becomes compounded when more than one bead is needed.

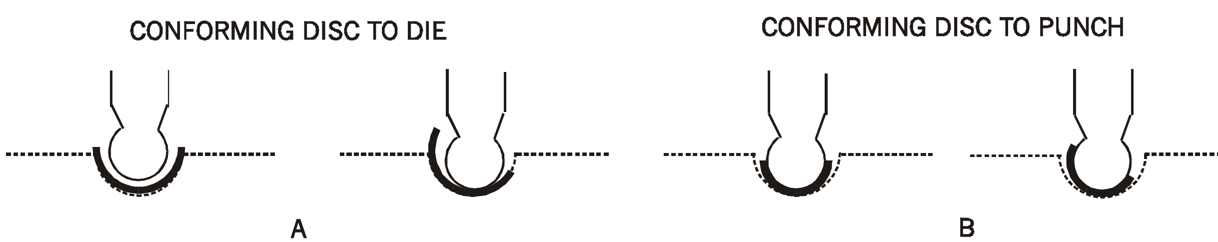


Fig. 6.12. Conform Disc to the Die or to the Punch. A is a disc that is formed to the size of the die. **B** is a disc that is formed to the size of the punch. The larger die size only is used as a backstop. The diameter of the disc in **B** is the punch size, plus twice the thickness of the metal.

Manufacturers provide die block impressions in a variety of sizes. To obtain every size you could buy a number of dapping blocks from different sources, but given the expense, this has its practical limitations. Instead, you expand the doming possibilities by using the punch as a form.

Before beginning, consider that a punch size provides you with the ***inside*** measurement; the punch size plus twice the thickness of the disc metal will be the actual diameter of the dome. The following is one way to dome using the punch sphere for the mold:

Step 1 Generally follow **Steps 1-4** outlined in **C. 1.** above. That is, start in a die impression that is several millimeters larger than the disc size and start with a punch that is smaller than the goal size. Punch straight down through a sequence of die impressions until you reach a die impression that is one size larger than your goal size (**Fig. 6.13A**), and the next die impression is one size smaller (**Fig. 6.13B**). In **Fig 6.13A**, the dome is well below the die rim and cannot be domed high enough for a complete half-sphere. The dome is moved to the next smaller die, but it is smaller than needed for a half-sphere because excess metal is above the die rim; the 7 mm punch (a size in-between the two dies) is the best fit for a half-sphere. For example, to make an 8 mm dome, use a 10 mm die and a 7.5 mm die with the 6 mm and 7 mm punches.

Step 2 Use a 6 mm punch in the 7.5 mm die (**Fig. 6.13B)**, and punch straight down. The dome should end up smaller in diameter than the goal size of 8 mm and be a rounded cone shape. This dome will be several millimeters above the die rim.

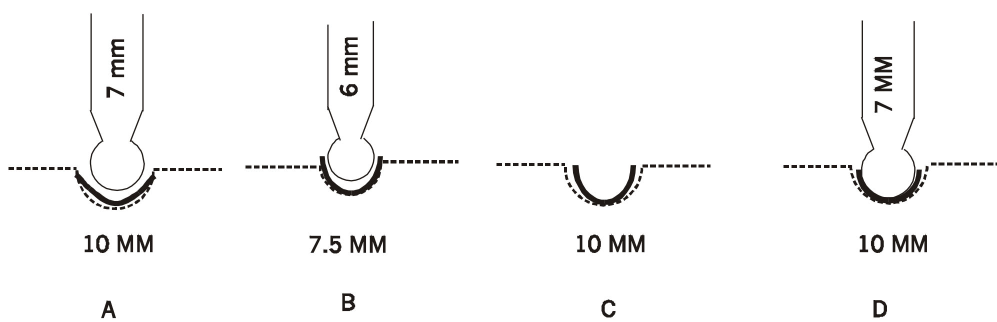


Fig. 6.13. Dapping to Punch Size. The die in **A** is too large for the disc size to dap a half-sphere dome (the dome rim must be even with the die rim). Placed in **B** with a smaller dapping punch, this size is too small for the disc size (note the amount of extra metal above the die rim). Return the smaller disc (**B**) to the 10 mm die (**C**), and use the 7 mm punch to dome the disc to an 8 mm diameter in **D**. The 8 mm diameter dome fits the 7 mm punch, not the 10 mm die **(D**).

Step 3 Oil the sphere on the 7 mm punch to help remove the dome from the punch. Return the dome to the 10 mm die impression and take care to punch straight down so that the narrowed dome conforms to the 7 mm punch sphere. If your estimated measurement for the disc size is correct, the dome will be slightly higher than mid-point on the punch sphere (**Fig. 6.13D**). Slide and tilt the dome on the punch head as far as the punch tool allows to round out the dome.

For rounding out and corrections:

a. When using the 7 mm punch for rounding out, be sure to tilt the dome as far down from the die rim as possible to ***punch on the dome rim all around***, or you risk curling the dome over and beyond the mid-sphere point. Once this happens, the only way to remove the dome is by prying the dome off the punch; or,

b. Sand the dome to the actual height (**Chapter 7**), so that you can return to doming to tilt the disc in the 7 mm size punch and round out the half-sphere using the 10 mm size die as a backstop. Do not round off the outside of the dome form with a hammer, unless you intend to add a texture. Measure the dome height and stretch the metal upward by dapping, if needed, and repeat sanding as indicated in **Chapter 7**.

Record your methods, size and sequence of punches and dies used, so that you can replicate the half-sphere sizes as many times as needed for your project. You may wish to use the form in **Appendix B** for notes. What becomes evident, however, is that these domes are more time consuming. If you plan to make a large number of beads, consider instead bead sizes that are possible by fitting the domes to the die block sizes.

D. Doming Problems and Their Corrections

1. The Dome is Off-center

For off-center bead holes on the dome, if the dome fits within the die rims, tilt the dome to its correct orientation and punch once to reestablish the center. A more drastic off-center hammer blow is likely to occur when the disc starts out above the die rim (**Fig. 6.14A**); a slightly off-center blow converts the rounded cone shape into an egg shape as the disc moves to the bottom of the die. (**Figs. 6.14B and C**.) To correct this off-center movement, tilt the dome so that the larger, stretched side is below the die rim and tap-hammer (one stroke) the disc to curl that edge inward (**Fig. 6.14D**). This allows the entire disc to fit inside the die; center the bead hole and use one stroke with the punch to restore the correct position.

2. Dome Stuck in Die – ½” Disc

If your dome will not budge from the die, as frequently happens, try pushing the dome edge with a wood dowel. Or, take a small punch (e.g., 6 mm) and “tap, tap, tap” all around a millimeter or two below the top edge. Next, try tapping midway down.

Usually, the ½" domed disc only becomes stuck into the goal size die. The reason the dome is stuck is because the disc is not perfectly round; the diameter of the disc may be wider than the die and held to the sides of the die by spring tension. In addition, because the height of the dome is slightly more than the diameter (so that there is room to sand down the rim), when the dome is slightly tilted in the die, the dome will be stuck.

In **Fig. 6.15** below, the dome as a "rounded-cone", is stuck in the die. (Often the dome "looks" perfectly rounded; however, if it were perfectly round then the dome would not be stuck.)

Use a smaller punch, in this instance, a 6 mm punch, to sink the silver where it is not conforming to the die. This action, directed about 1/3 up from the bottom, pushes the metal to the die and moves the dome rim inward. The most productive hammering is where the dome does not yet conform to the die – hammering elsewhere when the metal touches the die only hardens the metal.

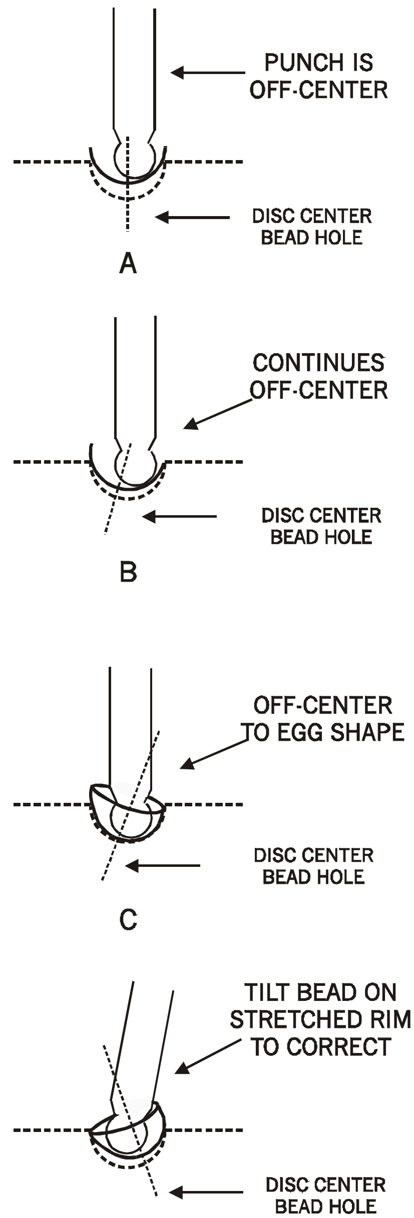


Fig. 6.14. Correcting an Off-center Dome. In **A**, the punch starts out off-center. As the force of the punch moves downward, one side of the disc moves down below the die rim but the other side moves upward (**B**). The final result is **C**, where the disc has become off-center and egg shaped. **D** is how the disc is corrected. The dome's stretched side is tilted below the rim and punched to curve the excess metal inward so that the whole dome will fit within the die rim; the dome can be re-centered by punching on the bead hole.

3. **Dome Stuck in the Die - other than the ½" Disc**.

Sometimes the dome is stuck at dies several sizes larger and before the goal size. The same rounding-out process indicated in **2** above must be done, but, hammer blows need to be kept to a minimum so that the base of the dome arc is not expanded to a size that will not fit into the smaller goal size die. First, tap all around just below the dome rim. Next, try one hammer blow at each "corner" of the dome just above the center point, where the rounded-cone shape of the dome is not conformed to the die (**Fig. 6.15, arrows**).

(Exaggerated to show effect)

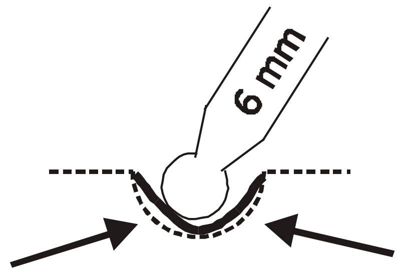


Fig. 6.15. Removing Dome Stuck in Die. The dome is stuck in the die. Use a small punch, a 6 mm punch in this example, and hammer the punch midway between the bottom and the rim of the dome as shown by the two arrows. This action will conform the dome to the side walls of the die and move the dome diameter inward; the dome will come loose. There should be no reason to damage or gouge a dome when it gets stuck to the die.

If the dome is oversized relative to the desired final bead size, the dome will become stuck in the die any time the hammer blow is slightly off-center. This is one reason why it is better to estimate the disc size as closely as possible to the final bead size, as discussed in **Chapter 11**.

In summary, there should be no reason to damage or gouge a dome when it gets stuck in the die. Rounding-out the dome will allow you to safely remove the dome. If the dome becomes stuck on the punch tool, however, the remedy may be destructive, so the better strategy there is avoidance (**Section C.2., Step 3**, above).

4. Dome Shape Problems

Two problems are common:

a. The half-sphere is still a rounded cone shape as it is in **Fig. 6.16A**.

b. The half-sphere has a high shoulder. This shoulder occurs because the edges scrape past the die rim at the beginning of Step 5; the “cone” shape (**Fig. 6.16B**) is still there because the body of the dome was not fully rounded.

These problems are subtle and may escape notice until after the domes are soldered. When you think you are rounding the dome body, the metal is too hardened and doesn’t respond. Anneal and repeat rounding.

(Exaggerated to show effect)

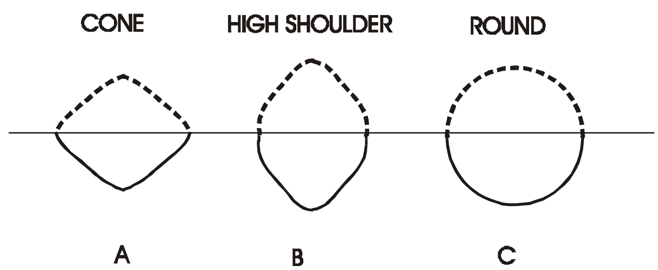


Fig. 6.16. Shape Flaws when Domes are not Rounded. A is a cone shape that was not rounded completely in **Step 5**. **B** is a rounded cone with edge scrape marks that form a " high shoulder" from the die and that need to be corrected in **Step 5**. **C** is a fully rounded bead.

I have seen some finished handcraft beads on the market with a "high shoulder," but once you are attuned to it, you will see it as a flaw.

Correct any doming problems before you begin sanding. Pay special attention to the shape and whether or not the bead holes are centered on the domes.

7
Sanding the Half-Spheres

The sanding procedures in this chapter primarily relate to leveling the bottom edge of the domes so that all of the domes in a grouping are the same height and diameter. **Sections A** through **C** below describe the methods. The center point or bead hole should be correctly oriented in doming; however, you may need to correct an off-center bead hole caused by off-center sanding. Correct the centering by sanding and doming a second time, as indicated in **Section D** below.

A. Sand Absolutely Flat

Lay a full sheet of 220-grit aluminum oxide or 320-grit silicon carbide sandpaper on a flat smooth surface. Sand the bottom edge of each half-sphere absolutely flat. The sandpaper needs to be 220 or 320-grit so that the edge of the half-sphere will have enough "tooth" to hold flux. The rim ledge should be rough, not smooth.

If all of the domes are sanded flat, then any half-sphere will fit flush with any other half-sphere in your group. A completely conforming fit is needed for soldering; no light should show through the seam. Use one dome as a "standard" and match each newly sanded dome to it.

B. Move the Dome in a Circular Motion

Hold the dome with the tip of your thumb and side or tip of your index finger. Use Alligator Skin®, a cloth mesh tape with a slight tack, to wrap around your fingers. This tape helps you to grip the small domes as well as reduces blistering if you grip the bead with your thumb and the side of your index finger. Or, for beads with a top bead hole, use a round toothpick in the bead hole. Hold the bead down to the sandpaper by propping one end of the toothpick in the bead hole and the other end to the base of your index finger and use your fingertips to move the dome around the sandpaper.

Move the bead across the sandpaper in a circular motion. After a few circular passes, rotate the bead a quarter turn. Apply even pressure on the dome by circular sanding and rotating the dome as you proceed to best assure an even, flat surface that stays oriented perpendicular to the bead hole.

C. Keep Domes Uniform in Height

As indicated in **Fig. 6.11**, the outer edge of your dome should be even with the rim of the die. The inner edge of the dome will be slightly higher. Sand the inner edge of the dome flush with the outer edge. Inspect the results of your sanding frequently so that you sand enough, but not too much, to keep all of the domes uniform in height. Use calipers to measure the dome height (which should measure ½ of the diameter for a perfect sphere). If it is not high enough, return to doming to stretch up the edge, and, if it is too high, sand it down.

D. Correcting Off-center Bead Holes Caused by Sanding

These methods work best for half-spheres domes. As indicated in **Fig. 7.1A**, to make a correction, sand or file the dome so that it is perpendicular to the bead hole. The result is that it reduces both the height and the diameter over its original shape shown in **Fig. 7.1B**. If the corrected bead is used with another dome, the reduced height/diameter will result in a fit where the outer edge will only fit to the inner edge of a regular dome as shown in **Fig. 7.1C.** To restore the original dimensions, anneal the corrected dome and return to doming to stretch it up to its original shape. Concentrate on stretching the dome rim where more metal is available (see **Fig. 6.4**). This results in a dome that is thinner, but the edges will match at the outer edge as illustrated in **Fig. 7.1D.**

(Exaggerated to show effect)

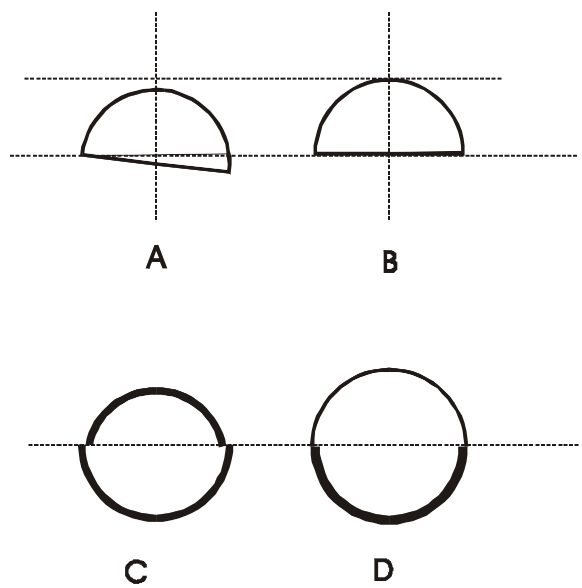


Fig. 7.1. Correcting Off-center Holes. **A** is a bead reoriented to correct an off-center bead hole. After corrective sanding, it is reduced in both height and diameter, compared to another dome (**B**). In **C**, the reduced size dome in **A** fits in the inner rim of a regular dome, leaving a lip. Instead, anneal and re-dome the half-sphere so that the outside edges match (although the corrected half-sphere will be thinner), as illustrated in **D**.

8
Soldering

Soldering a round shape is a challenge, and soldering numerous matching round shapes is even more of a challenge. Even an overly elaborate method will work for one or two beads. Soldering multiple beads, however, requires efficient strategies for constructing and arranging the soldering board and for positioning the solder. The techniques that I highlight in this chapter work equally well for one bead or for many.

A streamlined way to solder conventional beads is outlined, requiring only that you already have soldering skills, can safely use a gas flame and an acid pickle. For more information on safety issues, refer to any resource that describes basic soldering skills.

Section A includes descriptions of necessary equipment for the soldering process: the torch, the flux, the type of solder, and the soldering board set-up.

Section B describes my preferred soldering method, a combination of tack soldering, gravity placement, and butt joint soldering. In tack soldering (an alternative to balancing snippets), the solder is fixed to one dome before the two domes are positioned together for joining. This extra step, in fact, saves time. After tack soldering, the dome rim is rough sanded to remove solder at the joint. Metal is flush with metal; the "tooth" left by the 220 or 320-grit sandpaper provides space for the flux and solder. The solder is pulled into the joint by capillary action instead of "sweat soldering" (tinning) where the half-domes "float" on the solder (and can easily slide out of position).

> **Gravity** is the soldering placement method preferred in this chapter, without binding wires or clamping the domes together. Sometimes considered a technique reserved for advanced silversmiths, gravity alone is a particularly effective first choice for small beads (regardless of your skill level) because balance is easy to achieve with two half domes. I especially appreciate the gravity method, considering the difficulty encountered with the alternatives, which require props, clamps and binding wires.

Section C describes typical soldering problems and their remedies.

The next chapter (**Chapter 9**) expands the same soldering process described in this chapter, and presents different methods for soldering beads where the bead holes are on the soldering seam.

A. Equipment

1. Torch

I use a Bernz-O-Matic® Pencil Torch, available from jewelry tool suppliers, or hardware stores. I use a disposable propane tank, available at hardware stores.

If you use oxy-acetylene or oxy-propane, the flame is more controlled and burns much hotter. While these are nice features for soldering in general, it is not necessary for soldering beads. With beads, you never have a problem with heat dissipating too quickly; the main problem with beads is overheating so propane alone works just fine.

The following section is described as it works using the Pencil Torch and propane-air gas only.

2. Wire

Purchase a package of 22-gauge straight floral stem wire (35 count - $1) from a craft store. (Do not buy plastic, paper coated, or galvanized wire.) This wire will fit into your 18-gauge bead hole, but not flush, so that air can escape through the bead holes when you are drawing off the moisture from the flux. You will be cutting 2" pieces of this straight wire to hold the bead during soldering. This wire requires no special solder resist because it does not ordinarily solder to your bead.

Many jewelry-making authors recommend binding wire for securing the bead in place. This does not work well for small size beads. It takes incredible dexterity to bind a tiny bead together, and if you do, often the bead metal becomes so soft right at the soldering temperature that the binding wire sinks into the silver.

3. Soldering Board Arrangement

Use a 12" diameter rotating annealing pan with pumice. On top of the pumice, place a 6" x 6" square of asbestos-free hard soldering pad. On top of the pad, place a chunk (broken off a larger block) of honeycomb ceramic block – an irregular piece with about 1" square of top surface. This piece of honeycomb block is the soldering surface for the beads. The wire goes through the domes and down into the honeycomb block to support the bead alignment. Flux (and some water vapor) flows downward through the honeycomb block. In addition, the liquid flux seems to burn or drip off rather than build up on the honeycomb block, so one small chunk of block will last a very long time. Refer to **Fig. 8.2.**

When soldering is finished, the wire is removed; the hot bead is placed on the pumice to air cool, and then transferred to the pickle. This avoids the problem of a hot bead rolling or bouncing around your studio.

4. Flux

I use Batterns® self-pickling flux. Shake the container and pour a small amount of flux into a needle-tip flux dispenser bottle. Shake the dispenser before each use, and pour a small amount into a smaller container – I use small (3/4 ounce) plastic disposable paint cup containers sold in craft stores. Return the unused amount back to the dispenser bottle.

Needle-tip flux dispenser bottles are very useful for dripping flux over the bead domes and, when filled with water or baking soda, useful for flushing out the pickling acid. The tips are sold in 18, 20, 22 and 26-gauges. I use 18-gauge for flux and 20 to 22-gauge for water and baking soda. Periodically clean the tips in boiling water.

A thin amount of Batterns® flux can be painted on the inside of the bead shell, and, if heated slowly, produces a minimum of foaming or bubbling up.

5. Solder

I use “medium” sheet silver solder cut into small rectangular snippets. Also, the same “medium” solder is used for any corrective soldering. You could use “hard” solder equally well, especially if you plan more soldering at a lower temperature later to add design elements or other connections.

If you prevent flux from reaching soldered areas, the piece will not “unsolder.” You can use the same medium solder for all joints as long as previously soldered areas are protected from flux by a solder resist.

B. Soldering the Bead

As will be clarified in the following steps, I recommend holding the bead in place with “gravity” and flux, and again, gravity as an aide to solder flow – as the main method for successfully soldering small beads.

After sanding the dome edges flat (**Chapter 7**), pickling, and water rinsing, set up the beads for soldering.

Step 1 **Arrange the Domes into Two Equal Rows**. At this point, paint liquid “white-out” on any textured or stamped designs to protect them from solder.

Step 2 **Place the Domes over the Solder.** With one half of the domes, one-by-one, flux the inside of the shell then use fine-tipped tweezers in the bead hole to lift and lower the dome over two snippets (paillons) of "medium" solder, as shown in **Fig. 8.1B**. Err on the side of using larger pieces of solder rather than smaller; it is easier to remove the excess than it is to correct an incomplete solder.

Also, try to use two solder pieces that are about the same size so that the dome will stay balanced when it is propped on top of the other dome for soldering.

Step 3 **Flux.** Arrange each dome about an inch or so apart around the edges of a 6" x 6" soldering block. With a needle-tip flux dispenser or brush, drip liquid flux over the top of the dome. (Or, you could spray the flux, but a flux buildup on the soldering block shortens the block's usefulness.)

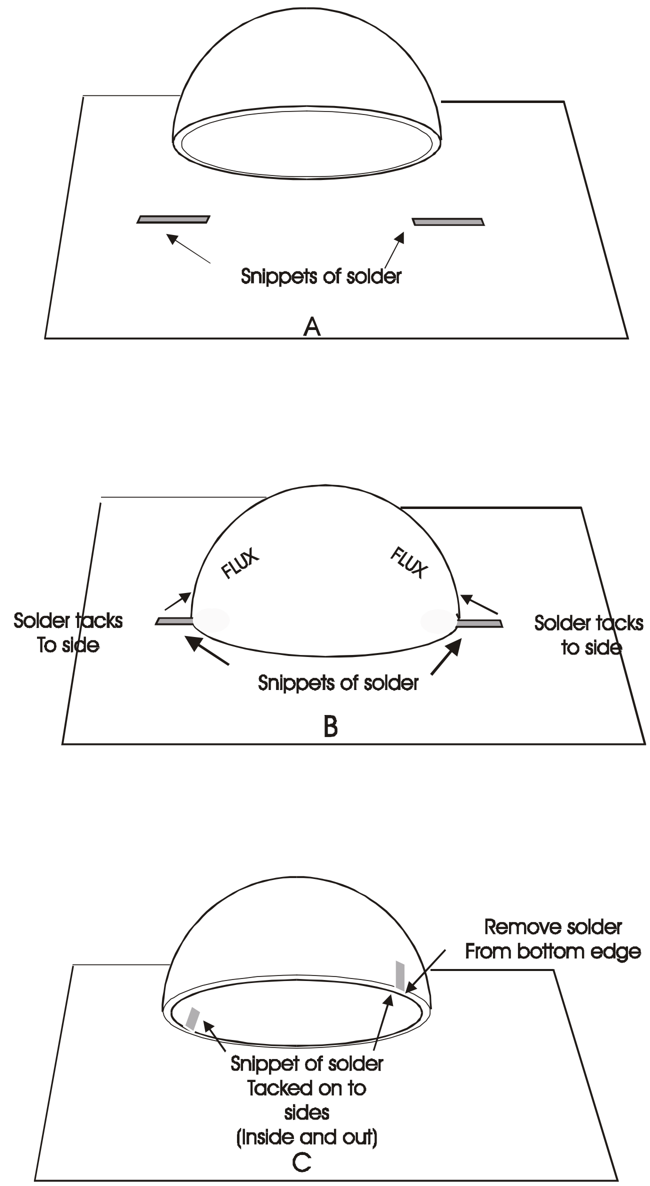


Fig. 8.1. Tack-soldering

The dome holds the solder in place so that when you heat the dome, the solder cannot "pop" out of place. (**Fig. 8.1B**)

SOLDER INSIDE TEXTURED BEAD

If you have texture or a design on your beads, consider placing the solder snippets ***inside*** the dome shell so that less solder flows to the outside edge. To do this, position the dome in an indentation you carve into your 6”x 6” soldering block to support the upside down dome to prevent it from warping. Flux the inside of the dome, place two pieces of medium solder on the inside, at the opposite edges, and heat the flux until it sticks the solder to the inside edge. Heat until the solder “tacks” to the metal (melts, not flows). Sand any solder off the edge, and continue as follows below; you will draw the solder from the inside to the outside of your bead.

Step 4 Tack Soldering

a. **Tack-solder**. Move in quickly with the torch to “tack” the solder to the sides of the dome (i.e., the solder melts but does not flow). If your torch is directed just above the solder on one side, usually the solder “tacks” to the other side at the same time. Quickly move from one dome to the next until all of the domes are tack-soldered.

b. **Sand**. Quench the domes in water and set on a paper towel to dry. With 220 or 320-grit sandpaper, remove the solder from the bottom edge of the domes (**Fig. 8.1C**). Make sure the rim ledge is not sanded smooth. This sanding is important for two reasons:

- The domes must fit flush. If a lump of solder obstructs this fit, the solder may not spread out at the last second and the result will be an incomplete solder that cannot be fixed; and,

- Solder on the rim can cause the domes to slide out of alignment such as might be expected from sweat soldering.

Clean the domes in pickle, rinse in the water dish and place them in a row next to the other (unsoldered) row of domes. (Re-apply “white out” over textures/stamp designs, if needed.)

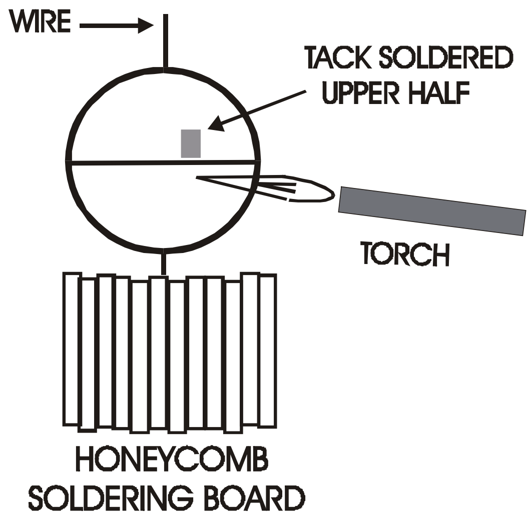


Fig. 8.2. Soldering Board Arrangement. A wire through the bead holes props the bead upright on the honeycomb block, but gravity and flux hold the domes in position. The upper dome is tack soldered. The torch is directed to the lower dome rim where the increased heat and gravity pull the solder down from the top dome to the seam line.

Step 5 Soldering the Domes Together

a. **Flux**. Use fine point tweezers to pick up the domes. Dip a tack-soldered and an unsoldered dome in liquid flux and drain off the flux by placing the domes bead hole side down on the soldering board. Touching only the wire, thread a 2" or so length of floral stem wire first into the tack-soldered half, and then the other dome. I do not use my fingers to touch either the domes or the soldering board during this set-up. Because I solder multiple beads, the soldering board can be hot from the previous solder.

b. **Place Wire in Position**. Using the tweezers, place the end of the wire, with the domes in position, into the honeycomb chunk of solder board, as shown in **Fig. 8.2**. The tack-soldered piece is on the top. Brush (or drip) the liquid flux over the outside of the dome.

c. **Align for Soldering**. With your tweezers (fingernail, or any other tool that works), nudge the bead halves into perfect alignment. Rotate the annealing pan to check the bead from all directions. A perfectly aligned bead hole centered on the dome aids in aligning the bead for soldering. Sometimes the bead settles into place almost immediately. With other beads, you may need to adjust and readjust as the top bead shell slips too far to one side, only to slide too far somewhere else. If the domes are floating on too much flux, gently push the top dome down to squeeze out the excess. Because the soldering area is relatively dark, keep a flashlight handy to check the alignment. Don't solder until you are satisfied with the fit.

Step 6 **Flux**. In your adjustments, if you have removed some of the flux, drip on more flux (without touching the bead) so that it runs down the outside of the bead.

Step 7 **Slowly Warm Bead**. With the metal torch tip no closer than the edge of the annealing pan rotate the pan and slowly, very slowly, warm the bottom half of the bead so that flux moisture on the inside of the bead is evaporated out through the top bead hole. Warm the bead for a much longer time than you think is needed. Wait until the flux turns powdery, especially along the seam line.

- What you are trying to do is prevent the flux from foaming up inside the bead. Also, you warm the bottom half first so that the water vapor can escape out of the top of the bead before flux on the top dome blocks the escape hole. If you move the heat in too fast, the foam/bubbles from the flux will close up the top bead hole and lift the top dome up off the lower dome (**Fig. 8.3B**). When the flux burns down, your bead likely will be repositioned out of alignment. Use flat nose pliers to loosen the flux to correct the fit, but if this doesn't work, take the bead off the board, pickle, rinse, flux, and start again.

> Sometimes you luck out and the bead falls back together in alignment just before the solder flows; but, you have invested a significant amount of time in your bead up to this point, so hoping for good luck is not worthwhile.

Step 8 **Final Solder.** When the flux turns a dry powdery white along the seam line and at the top of the bead hole, rotate the pan perhaps faster than usual because the small bead in the center of the pan is not rotating as fast as the pan edges. Move in quickly to solder; if you are too cautious, the risk of fire scale, burning out the solder, or meltdown rapidly increases. Direct the torch tip at the lower dome's edge so that the heat travels upward and heats both domes. On a larger piece, you can watch the flow of solder as your torch moves across the metal. However, with these small beads, the whole piece heats up so quickly that the solder seemingly flows “all at once.” Be ready to quickly pull the torch away.

MELTDOWN

If you are curious about how a bead looks just before meltdown, you could wait for it to happen, or, you could sacrifice a bead for the learning experience (or you could claim that’s what you are doing). You are at the brink of meltdown when:

-The red/pink color of the heated metal intensifies (sometimes you don’t notice this because you are watching the solder line).
-You notice the bead appears to swell up.
-The surface of the metal looks like swirling mercury.
-The bottom of the bead sinks, or, the top of the bead slowly collapses. The first areas to overheat are the dome centers where the metal is thinner (see **Fig. 6.4**).

The whole process of meltdown is not very dramatic. If you quickly pull away the torch just when slight swelling occurs, sometimes your bead can be rescued. After that, your bead is off to the recycle bin.

Step 9 **Remove Wire and Air Cool.** After soldering, remove the wire from the bead with pliers or tweezers, and move the hot bead over to the pumice to air-cool. Do not quench the hot bead in water or pickle. Also, take care in handling a hot bead so that it does not end up rolling across your workbench or on the floor. If the wire is stuck to the bead, see **Section C**, below.

Air-cooling allows the metal to become more hardened.

However, if you practice on 24-gauge copper beads, this annealed state is so soft that you need to put the soldered copper bead into a doming block and tap all over with a plastic mallet. I don’t think silver needs this extra step.

ALERT?

It’s at this point that you need to decide how many beads you can solder at one sitting. Soldering requires alert-focus. After 2, 5 or 10 beads, whatever your personal limits might be, if your mind begins to wander, STOP. Go do something else. If you persist when you cannot concentrate, you will make disappointing errors.

Step 10 Pickle. Place the soldered bead in the pickle after the wire has been removed and the bead is cooled. If you have covered a textured or stamped design with "white-out," rub off as much as you can before pickling.

Step 11 Rinse out Acid. Move the bead from the pickle to a shallow dish of water, then place the bead on a paper towel, with the holes in a up/down position, to allow the liquid (likely acid) to drain out. Inject the bead with water from the needle-tip flux dispenser or transfer the bead back to the water so that the inside fills up with water and drain the bead again on a paper towel. Use an ultrasonic cleaner, if you have one. If not, continue the water flushes several more times. You want to make sure that if liquid comes out of a bead onto your hands at some later point in sanding or polishing, that the liquid is water. As you know from other uses of the pickle, the acid continues to be corrosive if not removed.

Also, with the needle-tip flux dispenser, you can draw bicarbonate of soda (baking soda), mixed with water, into the beads. If acid is present, the water will turn blue as the baking soda neutralizes the acid. Then you need to flush out the baking soda because it leaves a blue or white powdery residue.

At this moment, you question the wisdom of small bead holes – no question that larger bead holes are easier and faster to flush out.

Step 12 Check Solder Results. Check the solder line against a strong light to verify solder coverage. If coverage is incomplete, see **Section C**, below. You are now ready to sand and polish the beads (**Chapter 10**).

C. Soldering Problems and Their Remedies

1. Wire is Stuck to the Bead

If the straight steel wire going through the bead gets stuck, take all measures to remove it before you put the bead in the pickle solution. Because the wire is a ferrous metal, it will react with the acid bath and will deposit a coat of copper on your silver. The following are techniques for removing stuck wire:

a. Re-heating. Sometimes the flux forms a glass that connects the wire to the silver, and sometimes the solder flows around the wire, trapping the wire to the bead.

First try to remove the wire by re-heating the bead and quenching it in cold water. Sometimes the expansion/contraction differences between the steel and silver will loosen the wire.

Use insulated fiber-grip tweezers to hold the wire and suspend the bead several inches above the soldering pan. Direct the heat to the wire where it joins the bead holes. If you can determine which bead hole/wire is stuck (it is rarely joined at both bead holes), place this side down so that gravity and/or heat rising does the work for you. If flux or a small amount of solder is holding the bead to the wire, heat plus the weight of the bead, usually pulls them apart.

b. **Twist, Drill, File**. As a very last resort, you might try twisting, drilling or filing the wire out. Try twisting before drilling. You know twisting doesn't work when the wire breaks off at the bead hole.

   Filing or drilling works but often leaves a trace of steel in or on your bead. Even a small amount ferrous metal in the acid bath will deposit a coat of copper on the bead…and every other silver item in your pickling solution. Consequently, thoroughly clean and flood the bead in water as follows:

   - Set the bead, hole side up/down (vertical), on a paper towel to draw out the water and steel filings. Inject the bead with water using a needle-tip flux dispenser or immerse the bead in water again, and draw the water out on paper towels. Do this washing several times.

   Test for remaining steel impurities by putting the bead by itself in the pickling solution. If steel remains on or in the bead, it will copper plate (but you can sand off the copper from the outside of the bead); however, if steel filings fall into the pickling solution, you will have to discard the contaminated acid.

2. **Solder Did Not Flow**. About one in ten beads seems to be soldered, but when it is in the pickle, the two halves fall open – because the flux, not the solder held them together. Put the bead back on the soldering board, flux and solder again. This "under-heating" is an easier problem to remedy than overheating or prolonged heating of the solder, which burns out some of the solder alloys (toasting the bead).

3. **Solder Flows Along Outside Rim.** Another problem occurs when the bead looks perfectly soldered, but when sanding off excess solder (or if you drop the bead) the joint falls open. This happens when the inner ledges of the half-domes did not solder. The sanded ledge may not have had enough "tooth" to hold the flux or possibly the fit was too close (**Wilson**[12]). The solder runs along the outer edge, rather than in through

the joint by capillary action. This problem is easy to correct because the domes have not been damaged: start over at **Step 1**.

To check for this type of problem before it happens, make sure you see the flux powder along the seam line before it powders on the outside of the bead.

4. Incomplete Solder

a. Not Enough Solder. Fig. 8.3A. If just a small line did not solder, you can re-solder this area without much difficulty: pickle (drain off the acid), rinse in water (and drain), set the bead up with a wire on the honeycomb block, flux the area at and nearby the point of correction, place a snippet of solder above the unsoldered area, and re-solder. When you re-solder like this, take care to drain off any acid or water that may be in the bead, because the torch flame will rapidly drive off (spit out) acid/water during reheating.

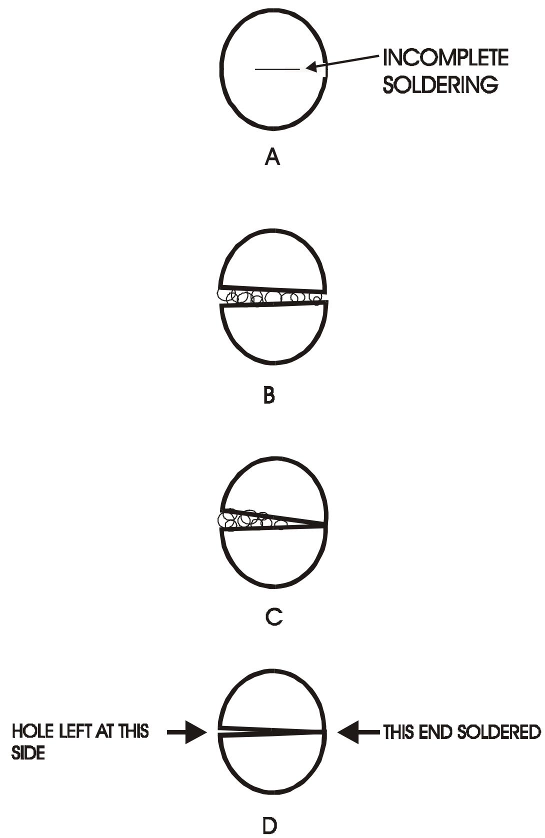


Fig. 8.3. Incomplete Solder. The line in **A** indicates not enough solder was used. **B** is a bead being lifted out of position by bubbling flux. **C** is a bead in contact at one end but raised out of position by bubbling flux. **D** is a bead that soldered together at one end but is not soldered at the other end, leaving a hole that will increase in size when attempts are made to close the hole by a second soldering.

b. Flux Lifts the Bead Out of Position. Figs. 8.3B through D. Sometimes the flux lifts up one side just enough to result in an incomplete solder.

When the bead is slightly raised by foaming flux, one side of the bead can solder, but as the lift progresses to the other side, the solder can no longer "fill" the gap. At first, you might assume that you could fill this hole; however, when you start to bring the area up to temperature, the solder precariously holding the bead together next to the hole “lets go” and the hole gets larger.

When you see a pinhole or gap in the soldered line, it is usually due to the flux lifting the bead up and away from a good fit. (This is different from a “line” of unsoldered joint showing, as in **4.a.** above.)

Often, a lump of solder on the rim of the dome causes a gap. During soldering, this lump of solder can hold the rims apart and prevent an even seal of solder all of the way around the bead. This is one of several reasons why I recommend sanding the tacked solder off of the rim in **Section B., Step 4**.

No successful correction can be suggested, although many have been tried (e.g., trying to get new solder to fill in, “un-soldering” the whole bead, sawing the two halves apart, etc.). Flatten this bead with a hammer before it goes to the recycling bin, so that you will never be tempted to “use it anyway.”

Prevent the flux from foaming up in the first place by regulating the amount of flux used and by very slow warming.

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9

Making Tilted Beads

Tilted beads, a variation of conventional beads (see **Fig. 4.2**), have their bead holes located on the solder seam. Information is provided on ways to mark each silver disc with the necessary center-to-diameter lines and to drill the holes. Methods for tack soldering and final soldering are the same as **Chapter 8**, except for the soldering board arrangement. For soldering, a spiral of wire holds the domes in place, aided by a "white-out" coated wire through the bead holes.

Steps for making a tilted bead.

Step 1 **Scribe Diameter Lines**. Starting at the center point, scribe a line through the diameter of two flat discs.

The center point, if marked by a scribe, and the diameter line will be ***on the inside*** of the dome. You want these guidelines scratched onto the inner surface so that they will remain visible after doming and edge sanding (but will not need to be sanded off as they would if the lines are on the outer surface).

Step 2 **Notch Bead Holes.** Dome and sand each disc half to a perfect fit (**Chapters 6 & 7**), then notch the location of the intended bead holes as follows. (**Fig. 9.1)**

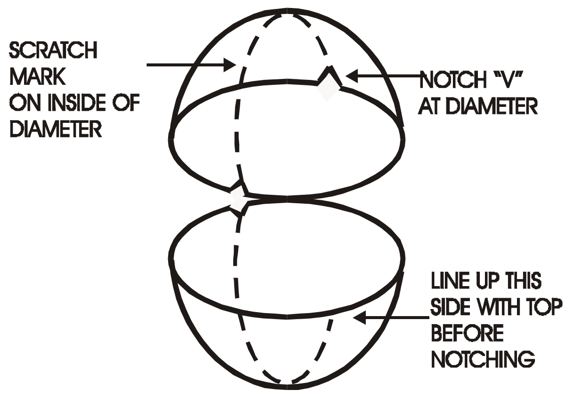
With a triangle needle file, on **Dome A**, notch a small "**v**" channel into each side edge where the diameter line is marked. On the second, **Dome B**, only notch a "**v**"on one diameter line mark. Match the "**v**" on **Dome B** with one of the two "**v**s" on **Dome A**. With permanent black ink, mark the spot where the notched "**v**" on **Dome A** is on the unmarked **Dome B**. At this ink mark, notch the second "**v**" on **Dome B**.

I recommend this method because if both **Domes A & B** are pre-notched at the diameter lines, the hole marks invariably will not line up. Even if the notch marks are only ½ millimeter off, you will need to widen the hole on this and every other bead in your grouping so that they all match each other. Also, the hole marks ***cannot be notched before doming*** because during doming the metal stretches and crimps the notch shut.

Mark each matched hole side as hole "**1**" and "**2**" with permanent ink so that you can keep the alignment the same.

Step 3 **Glue Domes Together and Clamp**. Super Glue® the two halves together. Use a size **#60** drill bit to make an 18-gauge, or one-millimeter

DOME A



DOME B

Fig. 9.1. Marking the Bead Hole Location. Diameter lines on the disc mark the points for locating the seam line bead holes. After notching, the domes are glued together; filing or drilling rounds out the marked holes. After removing the glue, one dome is tack soldered in preparation for the final solder.

hole (or drill a larger, final size hole, if desired). Clamp the bead so that the seam lines are held together.

Step 4 **Drill Holes**. With a micro power drill, use a high speed and very light downward pressure because the glue is brittle and will "pop" open. Drill through the holes marked by the matched "**V**s". Alternatively, use a bead reamer or round needle file to round the square holes you made with the two "**V**" cuts.

Step 5 **Release Glue**. With a torch held at least 5" away, heat the super glued bead just enough to warm the piece to release the glue. If the bead is warm but has not opened up, pick up the bead with tongs and drop it in cold water. Repeat as necessary.

Avoid overheating. If the temperature is too hot, the glue will flame burn. The flame seems to stain the silver a charcoal gray, which can only be removed by light sanding. This staining could be a problem if you have an etched, stamped or textured surface because the pickle will not remove it. For the same reason, peel off any remnants of glue that would otherwise burn up (and stain) during soldering.

Step 6 **Ink Mark Location**. Reassemble and align your bead halves together and ink mark which hole matches which side to insure soldering the correct sides together. Clean the domes in pickle.

This "personalized" way of drilling the holes means that you need to keep matched pairs together through pickling and soldering. If you are processing a number of beads, number each dome pair as well. (Pickling will not disturb the ink lines.)

Step 7 **Tack Solder**. Tack a piece of the medium solder on each side of one dome at the seam edge and sand off solder from under the seam, as indicated for conventional beads (**Fig. 8.1**). After pickling, align and reapply your ink numbers.

Step 8 **Flux Domes and Coat Wire.** Apply a light coat of liquid flux to the bead halves. Use a brush to soak up any flux that pools inside the domes. Coat a 1" or so length of straight steel floral wire with liquid paper "white-out". The "white-out" is needed on the wire here (but not for conventional beads) because the horizontal position of the wire increases the tendency for solder or flux to encircle or trap the wire to the bead.

On the soldering block, lay the coated wire across the unsoldered dome and into the drilled holes. Position the tack-soldered other dome on top. Double-check your numbering system to verify that the bead holes are correctly lined up.

The coated wire will support the alignment of the top and bottom halves of the bead holes and will keep the domes in position.

Step 9 **Spiral Support Wire**. Make a spiral of steel floral wire shaped like a cap to place over the bead, with a "tail" of straight wire at the end sufficient to bend down and poke into the "honeycomb" soldering block. Another spiral of steel wire may be needed to support the bottom of the bead.

This top spiral of wire will gently hold the bead in position while you solder (**Fig. 9.2**).

Step 10 **Warm Flux**. As indicated in **Chapter 8**, **Section B., Step 7**, slowly heat the bead until the moisture in the flux is drawn off and the flux has "glued" the bead in place. This time, the water vapor needs to escape from the sides of the bead, so you want to delay heating the flux nearest the bead holes until the last.

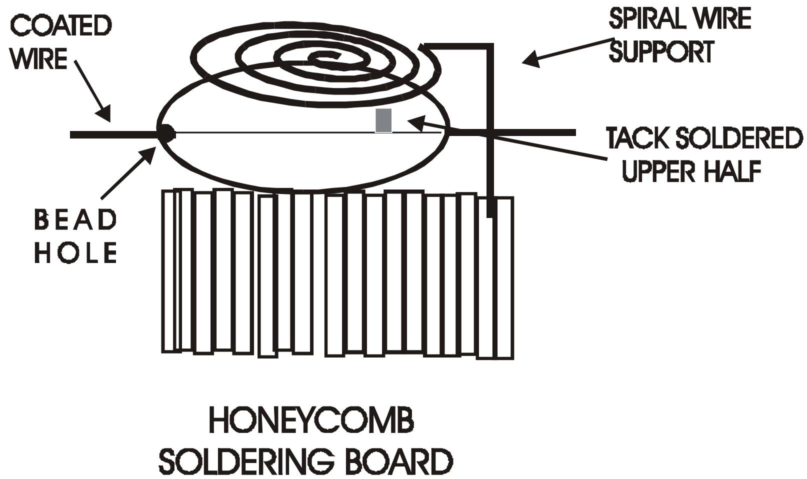


Fig. 9.2. Soldering Arrangement for the Tilted Bead. The domes are placed on the honeycomb block with the tack-soldered dome on top. A "white-out" coated wire is placed through the drilled bead holes. A reusable spiral wire is capped over the domes to hold them in place for soldering. The torch is directed to the lower dome so that the increased heat and gravity pull the tack solder down to the seam line.

Step 11 **Solder and Cool Bead**. Solder the halves together and, with pliers, remove the steel wire. Do not quench the hot bead in water or pickle. Air cool the bead so that the metal is allowed to go from annealed to somewhat hardened.

Set the hot bead aside on the pumice in the soldering pan so that you can use the soldering board arrangement to solder the next bead. Bear in mind that round beads roll easily, so be careful where you put them to cool.

Although rare, if the "white-out" coated straight steel wire going through the bead gets stuck, take all measures to remove it before you put it in the pickle solution. Because the wire is a ferrous metal, it will react with the acid bath and will copper plate your silver. For techniques on removing stuck wire, see **Chapter 8**, **Section C**.

Step 12 **Check Solder Seam**. After pickling, check the solder seam against a strong light to see that there is complete coverage. If correction is needed, refer to **Chapter 8**, **Section C.**

You are now ready to refine and polish the soldered beads. Proceed to **Chapter 10.**

10
Refining and Finishing the Soldered Bead

A. Holding the Bead

Before moving to any refining stages, you need a way to hold on to the bead and, when you set it down, you need a way to prevent it from dropping and rolling away.

Use a length of 22-gauge copper wire, thread it through the bead holes and out both ends to form straight handles, as indicated in **Fig. 10.1**. Leave the ends of the copper wire straight so that if you are using any machinery for sanding or polishing, the bead will safely pull free from your fingers if the bead becomes too hot or the bead gets caught on the sanding/polishing wheel. Copper wire, purchased in a spool from a hardware store, works well for this support because it is flexible and can be re-used several times before breaking.

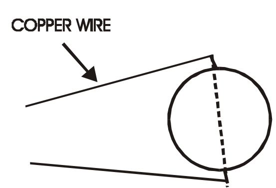


Fig. 10.1. Wire through Bead. A silver bead with a copper wire threaded through the bead holes provides a safe way to hold onto the bead during sanding and polishing. When hand sanding, grasp the wire between your thumb and index finger; bank the bead against the Alligator Skin® taped tip joint of your middle finger.

In addition, you need leather finger guards to help protect your fingertips from compounds, heat and abrasions when using an electric buffer or sander (available from jewelry tool suppliers or woodworking specialty stores). Also, you will find Alligator Skin®, a cloth mesh tape with a slight tack, useful to protect your fingers from abrasion and blistering.

B. Sanding the Soldered Bead

The goal of sanding is to smooth the surface of the silver bead until no scratches, nicks, or other surface flaws or excess solder remain on the bead before moving on to polishing. The location or direction of the solder joint should not be evident.

Avoid using electric belt or mini-drum sanders because these tools do not easily follow the contours of a round bead, can quickly remove too much metal and can add deep scratches. Compared to hand sanding, electric sanding does not seem to reduce the time or effort needed. Strategic filing with an equalling needle file (instead of hand or electric sanding) is a good way to remove lumps of solder.

Step 1 Use 220 or 320-Grit Sandpaper for Heavy Removal

Use 220-grit aluminum oxide or 320-grit silicon carbide sandpaper (see **Appendix C**) cut into 1” x 2” rectangles, to remove excess lumps of solder or to remove major flaws. Resist the temptation, on these small beads, to ***add*** sandpaper scratches where heavy surface treatment is not necessary – concentrate on the solder line and on specific spots elsewhere. You can add an enormous amount of time to finishing the surface if you unnecessarily sand in scratches that must later be removed with finer grits.

Step 2 Use 400-Grit Sandpaper; Removing Scratches from Step 1

Cut 1” x 2” rectangles of 400-grit silicon carbide sandpaper. In this step, you further reduce the scratch marks created in **Step 1**. Always sand in the same direction, or close to it, so that you reduce rather than increase deeper scratches.

According to Seppa[9] when you sand across the scratch marks, grit from the sandpaper comes off of its backing and is caught in the grooves of your metal, forming eddies of grit and metal which ***increase*** the depth of the scratch.

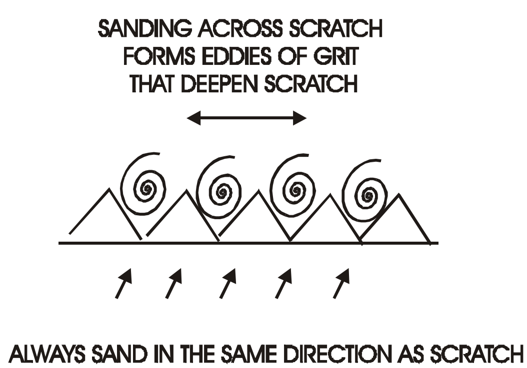


Fig. 10.2. Sanding Across Scratch. Sanding across the scratch lines causes the scratch to deepen because grit and metal form eddies in the groove. Sanding with the scratch line allows the grit and metal to be swept away.

In other words, the edge of the scratch on your metal is sanding the sandpaper, rather than the other way around. Wet sanding probably reduces this "eddies" effect, but the suggestions made here involve dry sandpaper.

Step 3 Use 600-Grit Sandpaper; Reducing Scratches from Step 2.

Continue to sand in the same direction as **Steps 1 & 2**. If you have any scratches that resist removal at this step, return to **Step 2**.

In addition to scratch reduction, you also want to use 600-grit silicon carbide sandpaper to sand off any film of solder that may have spread over the bead. At this step, you sand the whole bead.

Step 4 Transition between Sanding and Polishing

Review the surface of the bead, under strong light, to determine where more refinement is needed before moving on to polishing. If you see a solder line, pits or deep scratches, return to 600-grit or possibly back to 320-grit sanding. To successfully achieve a high polish, the bead surface must be a ***scratch-free satin finish***.

Sanding papers at 800 to1,000-grit, steel wool pads, and synthetic super fine sanding pads are available for further refining the bead. Note: if steel wool pads are used on beads that will be soldered again, fragments of steel wool will contaminate pickling acid.

Tripoli on a cotton wheel of a buffing machine is somewhere between sanding and polishing. If a buffing machine is not available, use sanding papers (600 to 1,000-grit) before moving from sanding to polishing papers (1,200 to 8,000-grit) listed in **Appendix C**.

One useful method for refining the bead surface is to use a very fine pumice powder (available from jewelry tool suppliers or from a dentist), mixed with water, to form a wet paste. H. Wilson[12] suggests using two flat sticks of wood covered on one side with chamois leather – one for use with pumice and olive oil and another stick for rouge and water. Or, use your fingers (or a wet plastic bristle brush on the Dremel® tool) to rub the bead surface until the metal achieves a scratch free satin finish. This satin finish, attractive as a final finish, provides a good platform for moving on to a high polish.

For the 3/8" round bead, I use tripoli on a yellow chemically treated cotton buff. After washing off the tripoli with dilute ammonia, I use

600-grit, then 4,000-grit polishing papers to refine the bead to a satin finish. The methods I use are labor intensive. All scratches must be removed before polishing because a mirror finish will magnify every flaw.

You may find some combination that works better for you. Experiment…every book on jewelry making offers useful ideas.

C. Polishing the Sanded Bead

I use a red rouge charged chamois wheel on an electric buff. If a buffer is not available, work up to an 8,000-grit polishing paper, and finish with a rouge cloth. If the surface is scratch-free, you will achieve a high polish; no amount of polishing will remove scratches that should have been sanded.

D. Cleaning Polished Beads

Remove the grease/wax from tripoli or rouge used on a buffing wheel by cleaning with diluted ammonia. When this wax residue combines with skin oil or humid air, the grease will pick up dirt that is hard to remove.

- Use ordinary cream silver polishes, available at hardware stores. These polishes contain a thin wax that offers some protection from tarnish. The cream can be rinsed off quickly under running water before any significant amount of water can enter the beads.

- Do not use liquid tarnish removal dips that limit the time the piece should be submerged. This liquid will enter the inside of the beads and cannot be easily removed, especially if the beads are on a strand.

- Coat the beads with a non-yellowing lacquer. Jewelry tool suppliers sell a liquid lacquer, thinned with a solvent, or water based acrylic for dipping. If you use a brush instead of dipping, it is very difficult to avoid bubbles. Also, craft stores carry spray cans of non-yellowing acrylic. The better choice is a liquid dipping lacquer, such as Pro-craft®, or a liquid acrylic lacquer available from jewelry tool suppliers. Coated beads do not need any additional protection from tarnishing. Metal lacquers for gilding or metal lacquers sold in paint stores should not be used because they will turn yellow.

- For uncoated beads, hand polish with a rouge cloth, and store the beads in a pouch of zinc treated cloth (the kind used as linings for silver flatware chests) to retard tarnish, or, store them in small plastic bags to reduce exposure to air.

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11

Other Bead Sizes

To create other bead sizes, either larger or smaller than 3/8", figure out the best size disc for the final size bead you want. If the disc is too large, you will have metal to remove; if the disc is too small, you must change your plan and make a smaller or a flatter bead. Also, if the disc is too large, the dome height will be too high relative to the die size and the dome will easily become stuck in the die, especially with any hammer blow that is slightly off-center.

A. Die Size

Determine the bead size based on one of the die sizes in your dapping block (which varies by manufacturer). As indicated in the chapter on **Doming**, it is easier to orient your bead to the die size rather than the punch-sphere size. However, if you are making a graduated bead strand, you will inevitably be confronted by certain sizes that will need to be conformed to the dap punch.

B. Disc Size

1. **One-Third Reduction Method.** Many authors suggest that a final size round bead is about 2/3 of the size of the flat disc. However, a typical final bead size for a ½" (12.7 mm) disc actually is 9.5 mms (instead of 8.47 mm). This greater size may be due to metal stretching (and to some extent your personal touch) during doming, so the "1/3 reduction" should only be used as an estimate. However, I find this method consistently under estimates the final bead size; either one of the next two methods is more accurate.

2. **Finegold-Seitz[3] Method.** The authors describe the method for determining the size of the blank for a bowl. As **Fig. 11.1** illustrates, you draw a line from the center bottom to the half-sphere diameter in your elevation, then swing an arc from that edge to the base to determine the diameter of the disc. Again, this is an estimate because of the metal gauge and the amount of stretch due to hammer blows that occur in doming. This method can be useful for determining the estimated size of a blank needed for a dome that is less than a full half-sphere (e.g., ¼ domed, or oblate spheroid bead).

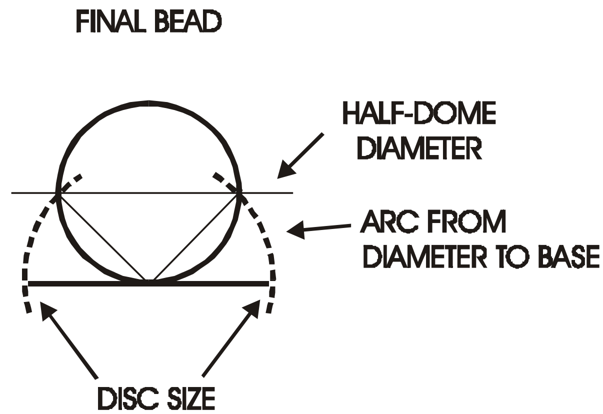


Fig. 11.1. Determining Disc Size Based on Size of Bead (Finegold-Seitz Method). Draw a line from the center bottom to the half-sphere diameter; then swing an arc from that edge to the base to determine the diameter of the disc. This method is useful for estimating the size of a bead that is domed less than a full round (e.g., a flattened bead).

3. **Revere[8] Method.** Revere describes the method for calculating the **disc size based on the size of the bead:**

Bead Size to Disc Size

$$\textbf{disc diameter} = \frac{(\text{bead diameter} - \text{metal gauge thickness}) \times \text{pi}^{*} \times 0.9^{**}}{2}$$

Example for a 3/8" diameter bead (9.525 mm) in 24-gauge metal (0.511 mm):

$$\textbf{disc diameter} = \frac{(9.525\text{ mm} - 0.511\text{ mm}) \times 3.14 \times 0.9}{2}$$

disc diameter = 12.7 mm (or **1/2")**

* pi = 3.14
**Because of expected metal stretching, a good rule of thumb is to take 90% of the theoretical figure for the starting size of the disc (Revere).

Or, said another way, to determine the **bead size, based on the size of the disc**:

Disc Size to Bead Size

bead diameter = (disc diameter X 0.71 mm) + thickness of 24-gauge metal

Example for a ½" disc (12.7 mm):

bead diameter = (12.7 mm X 0.71 mm) + 0.511 mm

bead diameter = **9.528 mm** (or **3/8"**)

DISC DIAMETER	BEAD DIAMETER
3/8"	7.3 mm
7/16"	8.4 mm
1/2"	9.5 mm
9/16"	10.7 mm
5/8"	11.8 mm
11/16"	12.9 mm
3/4"	14.0 mm
13/16"	15.2 mm
7/8"	16.3 mm
1"	18.6 mm

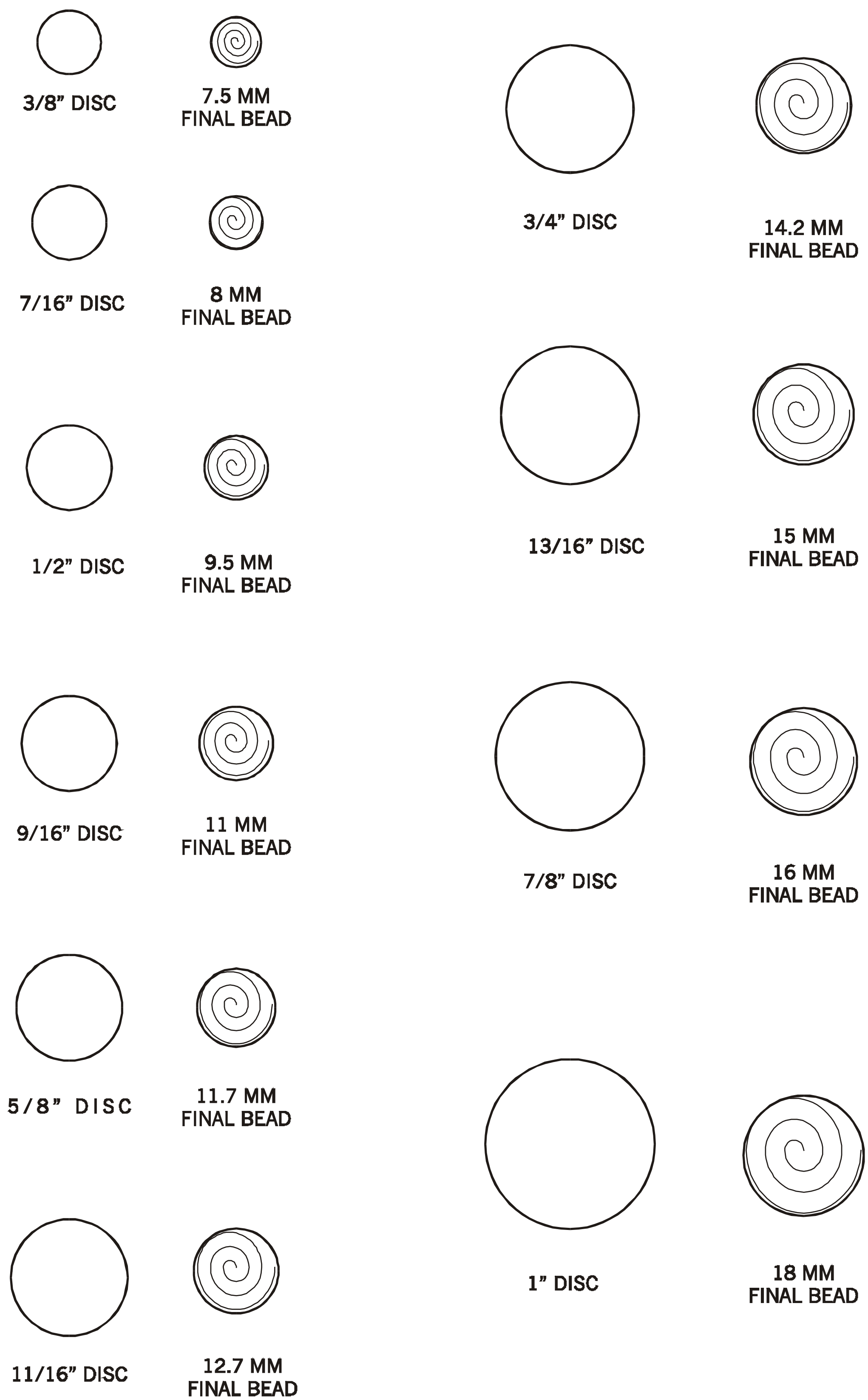
Fig. 11.2. Estimated Size of a Bead Based on the Size of a 24-Gauge (0.511 mm) Disc Using the Revere Method.

B & S Gauge	Metal Thickness in Millimeters
18-gauge	1.016 mm
20-gauge	0.812 mm
22-gauge	0.644 mm
24-gauge	0.511 mm
26-gauge	0.405 mm
28-gauge	0.321 mm

Fig. 11.3. Millimeter Thickness of Selected Brown & Sharpe (B & S) Gauges.

4. **Actual Experience**. **Fig. 11.4** is a table on the commonly available pre-cut 24-gauge disc sizes and the spherical bead size obtained based on actual experience with the tools listed in **Fig. 11.6 and Fig. 11.7.** Compared to actual experience, the estimated sizes, using either the Finegold-Seitz or Revere Methods, are good indictors for the actual sizes.

Fig. 11.4. Disc Size (Inches in Fractions) and Actual Bead Size (Millimeters)



DISCS/DIES IN FRACTIONS OF INCHES	INCHES IN DECIMALS	MILLIMETERS
1/4	.2500	6.350
17/64	.2656	6.747
9/32	.2813	7.144
19/64	.2969	7.541
5/16	.3125	7.938
21/64	.3281	8.334
11/32	.3438	8.731
23/64	.3594	9.128
3/8 ⊙	.3750	9.525
25/64	.3906	9.922
13/32	.4063	10.319
27/64	.4219	10.716
7/16 ⊙	.4375	11.113
15/32	.4688	11.906
1/2⊙	.5000	12.700
17/32	.5313	13.494
9/16 ⊙	.5625	14.288
19/32	.5938	15.081
5/8 ⊙	.6250	15.875
21/32	.6563	16.669
43/64	.6719	17.066
11/16 ⊙	.6875	17.463
3/4 ⊙	.7500	19.050
13/16 ⊙	.8125	20.638
7/8 ⊙	.8750	22.225
15/16	.9375	23.813
1 ⊙	1.000	25.400

⊙ pre-cut sizes that are commonly available and suitable for bead making (any size can be special ordered).

Fig. 11.5. Equivalents – Fractions/Decimals (in Inches and Millimeters) for Disc or Die Sizes Used in Bead-Making. The disc sizes that are commonly available in pre-cut disc sizes are marked with a bullet (⊙). A size smaller than 3/8" is too small for hand crafting, and bead sizes larger than 1" are not covered in this manual. Use calipers to measure the dimensions of the dies in your die block and record the numbers (fractions or decimals of inches, or millimeters, whatever your preference) on the die block template in **Appendix B**.

Fig. 11.6 below shows the dimensions of the die block used for the steps to doming in **Chapter 6**; and, **Fig. 11.7** is a table on disc size and the actual size domed bead. Also included is the height of the half-spheres before sanding and the last punch tool and die size used for each size half-sphere.

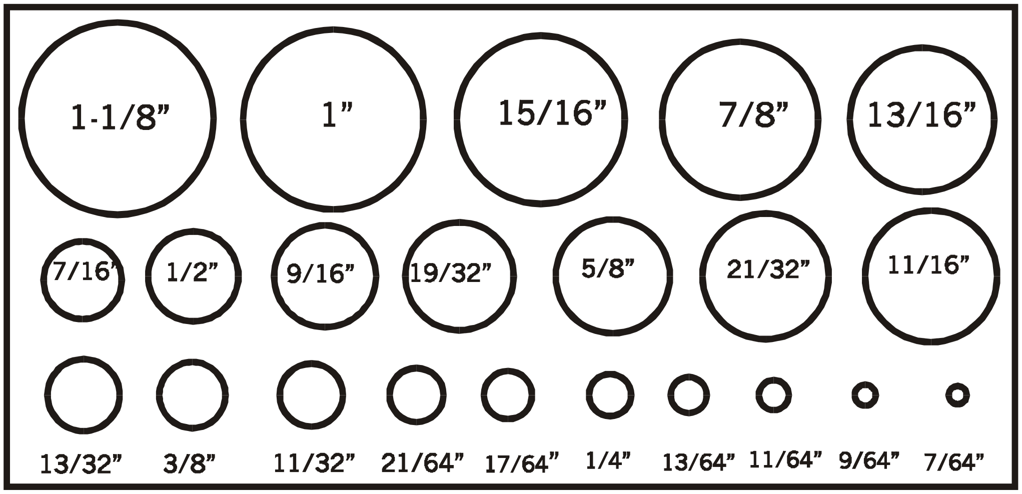


Fig. 11.6. Dapping Block Die Dimensions. The dapping block dimensions are given in fractions of inches. This die block and the punches listed in **Fig. 11.7** are the tools used to determine the final bead size.

1 Disc Size In Fractions of Inches	2 Disc Size in Millimeters	3 Actual Final Bead Size	4 Actual Half-sphere Height	5 Last Punch Used	6 Last Die Used	7 Formed To Punch (P) Or Die (D)
3/8”	9.525 mm	**7.5 mm**	4 mm	5.5 mm	17/64”	D
7/16”	11.113 mm	**8 mm**	4.45 mm	7mm	21/64”	P & D
1/2”	12.700 mm	**9.5 mm**	4.9 mm	8 mm	3/8”	D
9/16”	14.288 mm	**11 mm**	5.6 mm	10 mm	7/16”	D
5/8”	15.875 mm	**11.7 mm**	6.6 mm	10.5 mm	1/2” - 7/16”	P & D
11/16”	17.463 mm	**12.7 mm**	7.2 mm	11 mm	1/2”	D
3/4”	19.050 mm	**14.2 mm**	7.3 mm	12.5 mm	19/32”- 9/16”	P & D
13/16”	20.638 mm	**15 mm**	8 mm	14 mm	19/32” - 9/16”	P & D
7/8”	22.225 mm	**16 mm**	8.5 mm	14.5 mm	5/8”	P
1”	25.400 mm	**18 mm**	9.7 mm	17 mm	11/16”	P

Fig. 11.7. Dimensions for Round Beads. Col. 1 is a list of the most commonly available pre-cut disc sizes. **Col. 2** converts the fractions of inches in **Col. 1** to millimeters. **Col. 3** is the actual size finished (after sanding and soldering) bead, also listed in **Fig. 11.4**; the sizes that you might expect if your methods and tools are similar to mine**. Col. 4** is the actual height of the half-sphere (the diameter is the same as **Col. 3**) you can expect from using the punches and dies indicated in **Cols. 5 & 6.** In **Col. 4** each half-sphere, before sanding, must be larger than one-half the finished bead size (**Col. 3**), to allow room for sanding.

C. Select a Bead Size

When doming, many shapes lower than a full half-sphere can be attractive and desirable. Also, the flatter the dome, the less you have to deal with the die block creasing the dome. However, I think it is important to know how to achieve a full half-sphere so that when you select some size, it is by choice and not because you cannot make full use of the die block and punches.

Observe the die sizes in your die block and compare it with other die blocks on the market. Some die blocks offer more size options within the mid-ranges that are suitable for bead making. These blocks include more incremental steps that allow you to move smoothly through a progression toward the final goal size half-sphere. When those transitions are not available, you need to take more corrective actions as indicated in **Chapter 6**, **Step 5**.

I have made all of the sizes listed in **Fig. 11.4** and recorded the results in that table. What becomes evident is that in all of the sizes, at some point in the progression from larger/flatter to smaller/deeper, the dome sits above the die rim, typically at the final goal size, but also at one to two other die sizes.

Every time the dome sits above the die rim as you move toward smaller dies, you risk creasing the dome. At some die sizes, I cannot seem to avoid some creasing – but if the mark is shallow, it can be minimized by punching the lines down and, after soldering, by sanding. Use a small punch (e.g., 6 mm) on the inside of the dome to direct force on the outside by pushing the metal crease against the die block. After punching down the line, run your finger nail across a crease. If your nail catches on the crease, it is unacceptably deep. Deep creases cannot be removed without a significant loss of metal and an enormous amount of your labor. If you cannot seem to avoid those deep creases, then a change in strategy is indicated. The reason the dome creases on the die rim is because the dome diameter is too large for the size die. Move the dome back to one die size larger and use a small punch to hammer just below the dome rim (4 blows – north, south, east, west) to curl the dome rim inward. Also, at the goal size die, round out the dome with a smaller size punch first so that when the final size punch is used, the dome edges completely clear the die rim.

Some disc sizes in my die block are troublesome in the way they fit into the dies and require much more corrective action than other sizes (e.g., the 5/8" disc to an 11.7 mm half-sphere). Authors[6,13] who find using a die block so problematic that they only make shallow beads or recommend against even using a die block, may have selected the very size that their die block is least able to accommodate. I usually avoid making those troublesome sizes unless absolutely necessary for the design piece.

Also, with some sizes, (e.g., a 7/16" disc in my die block) the dome sits so high above the final die size (21/64") that it seems counter-intuitive to actually try the size. However, when the dome fits below the die rim at the expected goal size die, to achieve a full half-sphere, you must try the next smaller die (no matter how improbable it may seem). The results usually work out well as long as the dome edges first are curled inward before rounding out the dome, as indicated above.

Some dome sizes fit both the punch and the die (**Fig. 11.7, Col. 7**). In those instances, I curl the dome rims inward before the final die size to prevent creasing the dome edges. Next, I hammer the final size punch, first straight down, then tilt the dome as far as possible on the punch head to hammer the dome along its rim (but below the die rim) so that the dome does not become stuck to the punch.

D. Map Out the Plan

Before you order 200 silver discs in a certain size, try that size first in copper, then in silver. Annealed copper stretches more and creases deeper than annealed silver, so the final test should be with silver.

The best way to determine your preferred bead sizes over a larger range would be to use a circles template or dividers to mark out copper circles, and saw out discs (or use a disc cutter, if available) in the 10 sizes included in **Fig. 11.4**. Keep the domed sizes as a reference, including notes (**Appendix B**) on which sizes work the best (or not) with your die block.

Also, you may want to saw one of your copper domes down the middle to see how your domes stretch from the rim to the center.

Follow the principles of doming (**Chapter 6**) and develop your doming plan for each size/shape bead that you make. Use a photocopy of the suggested **Plan** in **Appendix B** to record your methods.

In summary, take into consideration the die sizes you have available in your dapping block to determine the disc size you need to match the die size. Cut the disc (or order pre-cut) sizes you need. This way, you know you have the tools you need because…they are the tools you have. You might not end up with beads that are the same standardized sizes offered by commercial manufacturers (e.g., 8 mm, 10 mm, 12 mm, round, etc.) but the sizes you make are, after all, your own signature beads.

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Appendix

A. Annotated Bibliography of Resources

B. Dapping Block Plan Sheets

C. Tools – Supplies – Suppliers

Appendix A

Annotated Bibliography of Resources

I wrote this manual because no other step-by-step resource was available; nothing detailed enough to help me successfully make a number of domed silver beads. This section is for the person who has already reviewed the steps in the manual.

What follows is not a comprehensive review, but a summary of the practical parts of each book that were meaningful to me. This annotated bibliography includes critical as well as positive commentary. Some of the following information consists of "what not to do" – authors' suggestions that did not work for me, or that even created problems. If problems were raised during my "field test," I attempted to develop some solutions.

Generally these authors considered making silver beads only as an aside and did not cover the process in sufficient detail for me; however, I am indebted for the information that they did include.

Below is the list of books that provided me some piece of the puzzle (e.g., about metal gauge, cutting discs, drilling bead holes, doming, or soldering) and influenced me to develop the methods in this manual. A number of these books are out-of-print. One source for locating out-of-print books is on the Internet at ***bookfinder.com***.

1. Branson, Oscar T., **Indian Jewelry Making**, Vol. I, Treasure Chest Publications, Tucson, Arizona, 1977, and Vol. II, 1979. $14.95 ea.

   Anyone interested in bead making will want a copy of these inexpensive books on Southwestern Indian jewelry, especially Vol. I., which includes illustrations and brief descriptions of bead making (cutting, doming, stamping and finishing). The doming process is not detailed, but my soldering set-up is a variation of methods suggested in this book.

   a) Disc Cutting. Discs are cut with a hand held "Arc Hole Punch" as described in **Chapter 3, Option 3** of this manual, and beads are made with 24, 26 and 28-gauge silver. As indicated in **Chapter 3,** the Arc Punch does not work very well for me on 24-gauge annealed sterling silver. Also, I do not recommend making sterling silver beads with thinner than 24-gauge metal.

   b) Soldering. According to the author, a 1/16" strip of solder is cut long enough to span the width of one dome and the other dome is placed on top, ample flux is applied, and the two halves are soldered. I find the soldering method described difficult in that the domes easily move out of position with the "ample flux." To avoid this problem, I recommend tack-soldering two shorter strips of solder onto the dome and sanding the solder off of the seam line before fluxing and (butt joint) soldering. Also, when sweat soldering with an ample amount of solder, the domes often "float" out of position when the solder flows.

I tried, and modified the methods included in this book, but the best part is that the book inspired me and encouraged me to continue…it is one of the few books available that actually describes bead making techniques. **These books (Vol. I & II) are a must buy.**

2. Coles, Madeline, **Jewelry – Two Books in One**, Sterling Publishing Co., New York, 1999. $24.99.

   The book pages are split, with the upper 2/3 of the page devoted to jewelry projects and the lower 1/3 on techniques. The lower pages can be moved independent of the top pages so that the techniques can be applied to any project, as needed. Doming is Technique #9.

   a) Doming. The author states that the punch should fit each depression tightly; however, this suggestion makes it hard to fit the dome into smaller sizes because the base of the arc becomes too stretched out. The author suggests that if the punch is too small, you will flatten the bottom of the dome. I find that if a punch is too small, it forms a bulge at the bottom of the disc; a larger punch distributes the impact of the hammer blow evenly outward from the point of impact. To smooth the bulge, I immediately change to a larger punch in the same die. Also, the author states that if you skip any stages (from larger to smaller dies), you will create a rippled effect around the edge of the dome. This must be what happens if you do not correct the bulge and continue to use a punch that is too small. I do skip some of the die impressions whenever the dome still fits ***inside*** the next and the next again smaller die. I do not skip die sizes if the dome will fit in the next smaller die but sits above the rim of the next die; the transition would be too abrupt. Also, not all die blocks include the same size die impressions; some have more "half" sizes.

   b) Drilling Bead Holes on a Dome. The author uses a steel divider to make several arcs across the dome until the arcs overlap at the center point. Tap a dent for the drill starter hole on the dome that has been placed over a dapping punch – two good ideas if you want the bead hole drilled after doming.

   c) Soldering. The author recommends first sweat soldering small paillons to the dome rim; for the final solder, a soldering wig supports the bead. I can't say whether a soldering wig holds the bead in position because soldering wigs are hard to find. However, placing tiny chips of solder around the rim of the dome (7 chips are shown in the photo) can be frustrating and tedious compared to the larger strips of tack solder that I suggest. The author tacks the solder to the rim; however, I remove the tack solder from the rim so that the disc pulls in solder from the bead sides and, (through capillary action) to the edges (butt joint soldering). This is done so that the domes are not "floating" on melting solder (and moving out of position).

Overall, this book does provide good information on the process of doming, drilling and soldering beads, and would be a worthy addition to your library.

3. Finegold, Rupert, and Seitz, William, **Silver-Smithing,** Chilton Book Company, Radnor, Pennsylvania, 1983. $39.95

   The authors briefly mention dapping beads and include photos of dapping tools; but the main focus of the book is on making large silver objects, such as bowls, boxes, flatware, etc.

   a) Bead Size. The most relevant information is on methods for determining the size of a blank needed for a bowl (which translates to determining the size of a disc for a bead). I have included this methodology in **Chapter 11**.

   b) Sinking Discs. The book includes excellent information on the "sinking" process as it relates to making a silver bowl (and indirectly for making domes for beads).

4. McCreight, Tim, editor, **Metals Technic,** Brynmorgen Press, Cape Elizabeth, Maine, 1992. $17.95.

   This book is a collection of techniques for metalsmiths written by 12 authors. "Toolmaking for Jewelers", by Tim McCreight is noteworthy for those who want to make their own design stamps and other tools.

5. McCreight, Tim, **The Metalsmith's Book of Boxes & Lockets**, Hand Book Press, Madison, WI. 1999. $29.99

   Hammer Blows. The author describes dapping dies and punches, and the doming process in general terms. He accurately describes hammer blows where you listen for the solid thump that tells you the punch has hit the bottom of the die so that you know when to move to a smaller die.

6. McGrath, Jinks, **The Encyclopedia of Jewelry-Making Techniques**, Running Press, Philadelphia, Pennsylvania, 1995. $24.95

   This book is a good visual guide of metal techniques and tools.

a) **Doming**. The dome should fit inside the die hollow at each stage or the hollow will mark the metal for a smaller bead. Techniques for shaping a large dome involve the use of a lead block or sandbag; the metal is shaped by punching from the outside edge of the metal, gradually working down into the center in a series of ever-decreasing circles.

b) **Center Point**. The author uses a circles template to locate the center point on a dome; a hole is drilled through one dome before soldering, and the second hole is drilled after soldering. The drill is placed through the first drill hole in order to drill through the other side. Refer to **Chapter 4, C., Option 3** for discussion on drill bit shank lengths.

c) **Soldering**. This author presents a forming method that avoids sinking the dome into dies that are smaller than the diameter of the disc. Shallow domes are soldered on each end of a cylinder or ring. First, a dome is soldered to a silver or copper ring that is slightly larger than the dome diameter; then the ring is sanded flush to the dome; finally, the second dome is soldered over the first dome. The lower dome is supported between two charcoal blocks, and solder paillons are placed outside and along the rim of the upper dome (i.e., butt joint soldering). This method is consistent with the author's doming methods because the ring adds height at the diameter for the partially domed halves. The dome cannot be fully formed to a half-sphere if you avoid using any die sizes that are smaller than the dome edges. Even with a relatively flat dome, I prefer to use a smaller die size and center the punch so that the dome edges scrape undamaged by the die rim. This easily accomplishes the desired height without using a ring.

7. Morton, Philip, **Contemporary Jewelry**, Holt, Rinehart And Winston, 1970. Out-of-print.

   Flushing Acid from Beads. The author provides a brief overview on embossing and dapping. To remove pickle from hollow beads, the author suggests boiling the beads in soapy water. He evaporates the water by warming the beads with the torch. Other authors recommend using the "hot" setting on a hairdryer. I avoid using a torch or any other high heat source because, I have learned, that oven temperatures as low as a 300^{O}F will (dis)color the silver to a golden amber.

8. Revere, Alan, **Professional Goldsmithing**, Chapman & Hall, New York-London, 1991. $69.95

   a) **Doming**. Revere uses a "sinking" technique where the area near the edge (but not on the edge) is formed first, and the center last. The metal is worked in a spiral pattern and punched in very small, uniform increments toward the center. The center is free from hammer blows until the last step. Revere points out that his domes are thinner at the center and the same or increased in thickness at the rim. Although the techniques are different, my domes thin the same way (**Fig. 6.4**).

Revere's technique is the sinking process outlined by Finegold and Seitz[3] for forming a 6" diameter blank of 18-gauge silver into a bowl (and the process of choice for spherical shapes over 1" in diameter). Revere's method of doming is considerably more time consuming than my approach for beads less than 1" in diameter.

The author states that when the disc will no longer fit into the next smaller die, you place the disc into that smaller die at an angle, with the edge of the disc over the center of the die. When you strike the punch, forcing that portion of the dome into the die, the dome temporarily becomes oval, or an egg shape. You continue to dap as the hemisphere is rotated around, with a different portion of the edge always entering the die. This action compresses the dome walls until the dome is the required diameter. I have used this technique only as a corrective measure, when the base of the dome is too wide (e.g., when the dome is stuck in the die and the only way to remove it is by widening the base). A silver disc can be tilted and rotated in a smaller die as long as the hammer blows stay centered in the die and the punch is small enough to keep the disc away from the die rims.

b) **Bead Size**. The author provides extensive tables on determining the amount of metal needed for a variety of different projects. I have included his formula for determining the size of the blank needed for a certain bead size in **Chapter 11**.

9. Seppa, Heikki, **Form Emphasis for Metalsmiths**, Kent State Univ. Press, Kent, Ohio, 1978.

   An interesting book of stunning sculptural silver forms which are of little relevance to bead making. The focus of the book is on developing new forms – sculptural forms not tied to a utilitarian function such as bowls, flatware, etc.

   Sanding Scratches. I was interested in the author's explanation why scratches are not removed (are in fact deepened), when sanding across the scratch instead of sanding in the same direction as the scratch. See **Fig. 10.2** in **Chapter 10**.

10. Untracht, Oppi, **Metal Techniques for Craftsmen**, Doubleday & Co., Garden City, New York, 1968, and **Jewelry Concepts and Technology**, Doubleday, NY, 1982. $125.00

    The 1982 book is an expanded version of the earlier book. This expansion, in addition to the hand drawings, includes photo examples of jewelry that illustrate the technique described. This is the definitive source for metal working techniques.

a) **Doming**. The author does emphasize that the punch is placed exactly in the center and hammered till it touches the bottom of the die impression, and then the disc is placed into the next smaller impression. Also, if the dome's edge becomes irregular, the author suggests that the dome be replaced in a depression that brings its edges level with the upper die surface and filed level. I don't recommend filing a dome in a die block when it is easier to level the dome on sandpaper and check the dome size using calipers.

b) **Drilling**. Holes are drilled after doming (from the concave inside), but before soldering for safety reasons. The author does not describe how the dome center is located.

c) **Lead Block.** When lacking a die block, the author describes using a lead block in conjunction with dapping punches. The dapping punch is used to form a depression in the lead block. The block is covered with paper to help prevent contamination of the metal by the lead.

Except for centered punch doming, I don't recommend the techniques described, but the descriptions are interesting. Unless you are a collector of old books (and must have both), the 1982 book is the best buy. The techniques described (and drawings) appear to be about the same as the 1968 version, and the price is about the same, but the photos make the 1982 book truly attractive and informative.

11. Weygers, Alexander G., **Complete Modern Blacksmith**, Ten Speed Press, Berkeley, CA, 1997, a reprint of three Weygers books: **The Making of Tools**, VanNostrand Reinhold, 1973; **The Modern Blacksmith,** 1974; and, **Recycling Use, and Repair of Tools,** 1978. $19.95

    Design Punches. The area of interest is in the last book (or the last section of the **Complete Modern Blacksmith**), Section 10 on Making Hand-Held Punches. The discussion includes cutting and designing a number of generic shapes to provide an infinite number of different designs. Involves hardening and tempering steel tools and requires oxy-acetylene gas.

12. Wilson, H. (Henry), **Silverwork and Jewellery**, Pitman Publishing Corp., New York & Chicago, 1902. Out-of-print.

    a) **Incomplete-Soldering**. Interesting book from a historical perspective but includes no information on dapping or doming. The author does describe an incomplete solder where the solder runs along the edge of a piece rather than entering the joint by capillary action – because the edges of the metal are too closely fitted together and not enough space is available for the flux and solder. This was the first description I have seen of an event that happens frequently, both in bead making and in soldering bezels. (See **Chapter 8, Section C.)**

b) Polishing. The author suggests hand polishing by using pumice with olive oil on a chamois that is fixed to a flat stick. See **Chapter 10**.

The author includes a lengthy discussion on the creative process and laments the negative effects on the creative process by machine made jewelry – still contemporary issues.

13. Winebrenner, D. Kenneth, **Jewelry Making as an Art Expression**, The Haddon Craftsmen, Scranton, Pennsylvania, 1953. Out-of-print

This is an extremely useful exposition on creative expression through jewelry design. It aims to awaken the inherent abilities in every person, to support creative expression with an exploratory environment, to cover design considerations and, to a lesser extent, metal working techniques. As my emphasis is to glean bead making techniques, the following critique is admittedly on a small portion of a book which was not designed to focus on specific techniques.

a) Doming. The author describes the doming process but recommends the use of a lead block as preferable over the steel block because the lead block is less likely to mark the disc. Damage to the disc may occur because the author suggests the use of a dapping punch that is the correct size for each die (which broadens the base of the disc too much and results in marring the dome). Also, the author suggests placing the disc over the proper size depression, and using a succession from smaller to larger dapping punches, and hammering the punch until the goal size punch is reached. The author is using the punch as a forming tool. However, this method involves starting with the goal size die and guarantees that the disc edges will be cut.

The author briefly mentions doming to form a sphere, but the main focus is on forming half-domes as components of jewelry, such as a substitute for stones in design units. According to the author, the steel die block is expensive, troublesome and unnecessary; a lead block should be used as the better alternative.

b) Soldering. The author advises using “medium” solder rather than “easy” solder because the medium solder will more nearly match the color of the silver. Also, he suggests the solder should be melted on the inside of the hollow dome first so that less solder will show on the outside seam – both noteworthy suggestions.

c) **Binding Wires**. The author suggests using light soldering tweezers or binding wires to exert a gentle pressure against the dome in soldering – methods that are difficult to accomplish. I found that either the tweezers pressure was too gentle to hold the domes together or that the tweezers tended to clamp in on the silver when the bead reached soldering temperature, causing the bead to be squished.

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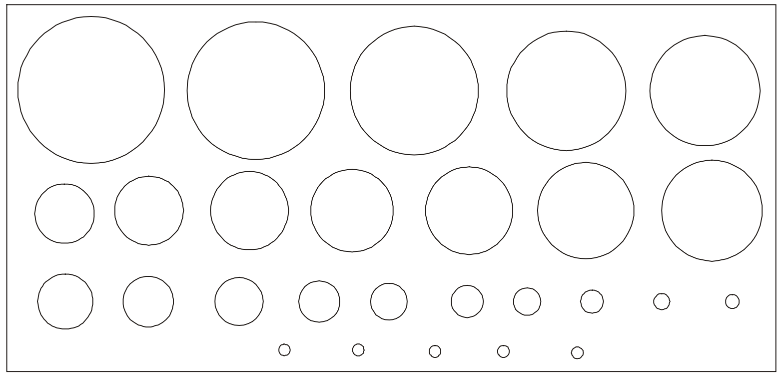
Appendix B

Flat Dapping Block Plan Sheet

Disc Size: ________________

Final Size Dome:
Diameter: ________________
Height: __________________

Punches Used: ______________



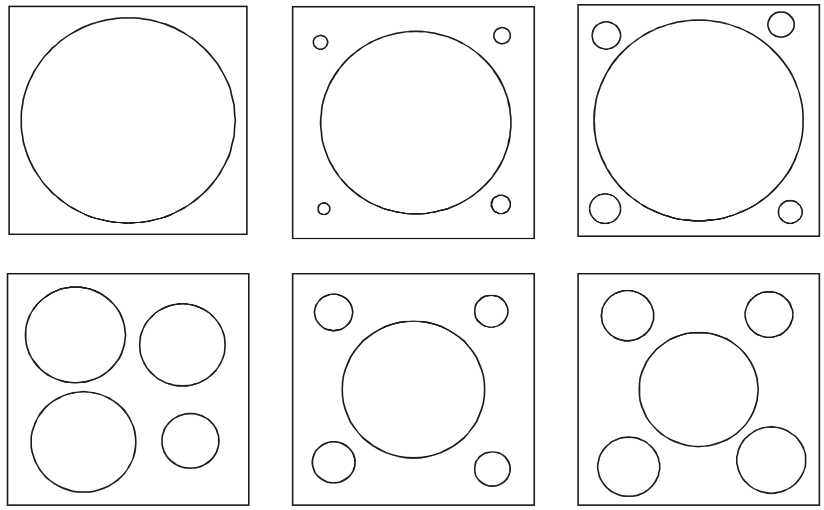
Die #:	Punch:	
Die #:	Punch:	
Die #:	Punch:	
Die #:	Punch:	
Die #:	Punch:	
Die #:	Punch:	
Die #:	Punch:	
FINAL:		

Cube Dapping Block Plan Sheet

Disc Size: ______________

Final Size Dome:
Diameter: ____________
Height: ______________

Punches Used: __________



Die #:	Punch:	
Die #:	Punch:	
Die #:	Punch:	
Die #:	Punch:	
Die #:	Punch:	
Die #:	Punch:	
Die #:	Punch:	
FINAL:		

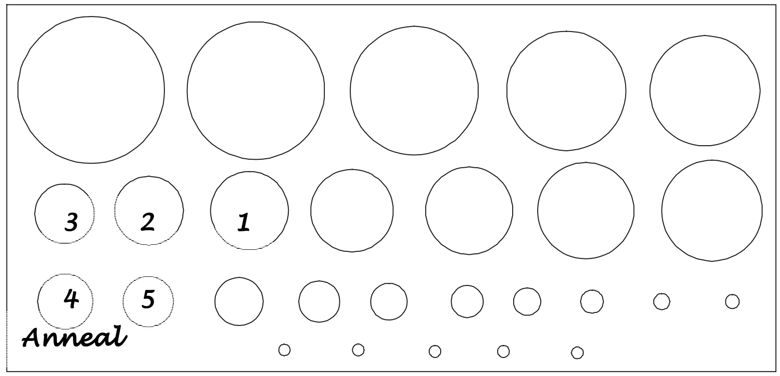
EXAMPLE

Flat Dapping Block Plan Sheet

Disc Size: 1/2"

Final Size Dome:
Diameter: 9.5 mm
Height: 4.9 mm

Punches Used: 6, 7, 8, 9mm



Die #: 1	Punch: 9 mm	
Die #: 2	Punch: 9 mm	
Die #: 3	Punch: 7 mm	Above rim to 1mm below rim.
Die #: 4	Punch: 7mm, then 6 mm	Slightly above die rim, ends at level. ANNEAL Use 6 mm punch on hole.
Die #: 5	Punch: 7 mm, Then 8 mm	(notes below)
Die #:	Punch:	
Die #:	Punch:	

FINAL:
1) Disc 1.5 mm above die rim at #5.

2) Use 7 mm punch first - punch down in three gradual steps.

3) Round with 8 mm punch.

- no creasing .

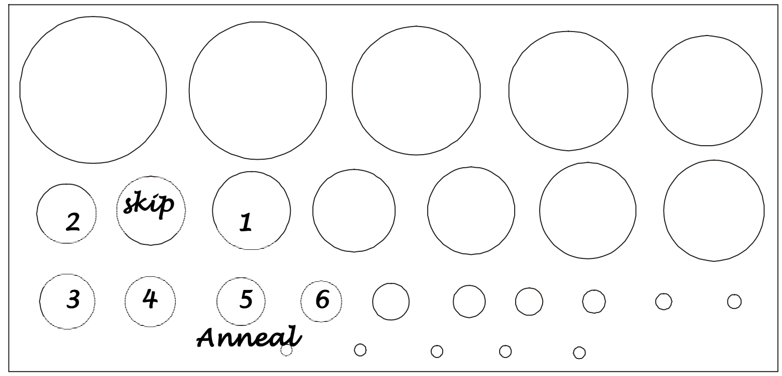
EXAMPLE

Flat Dapping Block Plan Sheet

Disc Size: 7/16"

Final Size Dome:
Diameter: 8 mm
Height: 4.45 mm

Punches Used: 4.5, 6, 6.5, 7 mm



Die #: 1	Punch: 6.5 mm	
Die #: 2	Punch: 6 mm	Slightly below die rim
Die #: 3	Punch: 6 mm	At die rim
Die #: 4	Punch: 6 mm	Start above die rim, end below rim
Die #: 5	Punch: 6 mm	Above die rim to even with rim - sometimes stuck (use 4.5 mm punch at rim). ANNEAL
Die #: 4	Punch: 4.5 mm	Punch on hole.
Die #: 6	Punch: 6, 6.5, 7 mm	(notes below)

FINAL:

1) In three gradual steps, use 6 mm punch in die #6, then 6.5 mm punch, then 7 mm punch to bottom of die.

2) After straight down punch with 7 mm, change to 6.5 mm punch to round out dome. End with 7 mm punch rounding on rim. (Punch & die tight fit)
- no creasing .

Appendix C

Tools – Supplies – Suppliers

Tools & Supplies

The following tools are important relating to the bead making techniques presented in this manual. I assume you have a basic workshop of general metal smith tools available to you.

Chapter 3
Circles template
Scribe
Steel dividers
Sterling silver sheet or pre-cut discs (24-gauge)
Jeweler's saw
Brass or copper pounding plate (from hardware store)

Chapter 4
Bead reamer
Center punch
Drill bits: #60 and #68
Micro drill (e.g., Dremel®)
Micro-collet adapter
Pine block of wood
Popsicle sticks
Round needle file - #1 and #4
Squares of stiff plastic (2" x 2"), cut from "blister wrap" packaging for tools, plastic folders, deli container lids (any plastic soft enough for the dividers to cut but strong enough to hold its shape).
Steel plates (two) 2" x 6" (from hardware store)

Chapter 5
Steel plates (two) 2" x 6" (from hardware store)
Steel rods (round & square)
Hallmark stamps (sterling, .925, numbers and letters)
Copper or brass pounding plate

Chapter 6
Dapping block and dapping punches – hardened steel
Mallet: 1 1/2" face size leather mallet or other suitable hammer

Chapter 7
Round toothpicks
220-grit aluminum oxide sandpaper

320-grit silicon carbide sandpaper

Chapters 8 & 9

"Medium" sheet solder
12" Rotating annealing pan with pumice
22-gauge straight floral stem wire (not coated)
22-gauge spool of copper wire
Batterns® flux
Bernz-O-Matic® Pencil Torch
Equalling needle file - #1 and #4
Fiber-grip soldering tweezers
Fine point tweezers
Honeycomb soldering block (small chunk of)
Liquid paper® "white-out"
Needle-tip flux dispenser (18 and 22-gauge tips). 4-pack assortment or 100 pack of 18, 20, 22 or 26-gauge tips)
Propane
Round needle files- #1 and #4
Scribe
Soldering block (6" x 6")
Super Glue®
220-grit aluminum oxide or 320-grit silicon carbide sandpaper
Triangle needle files - #1 and #4

Chapter 10

Alligator Skin® Mesh Tape
Leather finger guards
Powdered pumice, tripoli, rouge, rouge polishing cloth
Sandpaper: 320-grit, 400-grit & 600-grit (silicon carbide), plus 1000-8000-grit polishing papers (WetorDry® Tri-M-lte®),if desired.

Suppliers

Indian Jewelers Supply Co.
601 E. Coal Avenue
Gallup, NM 87301
1-800-545-6540
www.ijsinc.com
(Metals-Tools-Supplies)

Lapidary Journal
www.lapidaryjournal.com
(Annual Buyer's Directory of Suppliers and monthly magazine)
(Metals-Tools-Supplies)

Progress Machine & Tool Corp.
645 South Olive Street
Los Angeles, CA 90014
1-800-841-8665
www.progresstool.com
(Tools)

Rio Grande
7500 Bluewater Road NW
Albuquerque, NM 87121-1962
1-800-545-6566
www.riogrande.com
(Metals-Tools-Supplies)

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About the Author…

Strong interests in painting, ceramics and sculpture led to a BA degree in Art (minor in Psychology) from the California State University at Fresno. After graduation, I pursued a 32-year career in California and Wisconsin Human Services, the first 9 years as a social worker, and subsequent years as a social planner for the State of Wisconsin. I specialized in adult protective services and guardianship, writing policy manuals, policy issue papers and technical assistance documents. During this time, I continued to express myself in art classes, exploring pottery and ceramic sculpture, and was involved in making jewelry with semi-precious stone beads.

During the past three years, my interest in art and jewelry was furthered by learning metal working techniques in art metal classes at the Madison Area Technical College. My home studio is fully equipped for small projects such as bezel-set stones, lockets and the like, but my primary focus continues to be on silver beads. An avid reader, I have collected over 80 books on jewelry and metalworking.

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