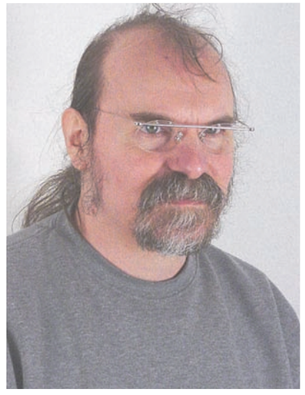

Author

Gerhard Schulz-Wahle
Born 1949 in Frankfurt a.M., Germany.
Watchmaker, Goldsmith.
Instructor at the Zeichenakademie in Hanau since 1989.
Other Books:
„Goldschmieden 2“ (Additional Techniques).
„Goldschmieden 3“ (Handmade Chain-necklaces).
„Fachrechnen für Goldschmiede“ (Calculation for Goldsmiths).
Awards:
1972 Honorable Mention International Contest, Silver Necklace.
1978 1st. Prize in DeBeers Contest: Diamond Jewelry.
1980 Honorable Mention in Design Contest B. Cellini, Hanau.
1992 Honorable Mention for design in the German Copper Institute Design contest, Berlin.
1994 3rd. Prize in Hessen Design Contest.

Translator

Michael Wönne
Born 1954 in Hamburg, Germany.
Goldsmith with certification from the Zeichenakademie Hanau.
Worked as goldsmith, instructor, gemologist, and diamond expert in several companies.
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Translator

Claire Selby
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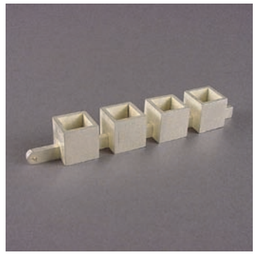
1998 Designer of self-made jewelry line “Claireware“.
2001 Scholarship for Art at Transylvania University, Lexington KY, U.S.A.
2005 Bachelor of Arts Diploma, Transylvania University (Major: Studio Art, Minor: Anthropology).
2007-2011 Apprenticeship at the Zeichenakademie in Hanau, Germany
2011 Award (graduation) at the Zeichenakademie in Hanau.
2011-2014 Professional goldsmith in Mannheim and Nürnberg, Germany.
Member of MADE IN HANAU since 2014, Hanau, Germany.
2014-2016 Masters school for Goldsmithing at the Zeichenakademie in Hanau.

GOLDSMITHING 1

GERHARD SCHULZ-WAHLE

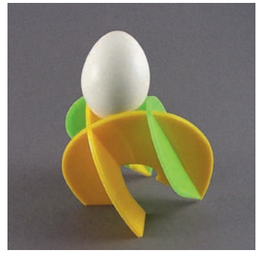


GERHARD SCHULZ-WAHLE

GOLDSMITHING 1

Basic Goldsmithing Techniques

Translation from German to English by
Claire Selby and Michael Wönne



GERHARD SCHULZ-WAHLE

GOLDSMITHING 1

Basic Goldsmithing Techniques

Translation from German to English by
Claire Selby and Michael Wönne

Introduction

This book is an aid for the practical skills in goldsmithing.

It should be helpful as a communications tool between instructor and trainee.

All commonly found worksteps and topics are described. The work projects follow each other in a logical order; each technique is described once, then assumed as known for all following work pieces.

In this book, only one work method is suggested for each process; other alternatives, however, can be found in the workshop.

Every time a new tool is used, it is cited at the beginning of the chapter and provided with a number in the text.

In the appendix, more information is given for the new tool under this number. The same goes for all necessary supports.

One or more design examples are shown at the end of each chapter.

Where necessary, technical drawings are added at the end certain chapters. Additional descriptions of the technical drawings are also given as needed.

I had a stroke of luck with the translation of this book from German to English.

Ms. Selby came from the U.S.A. to Germany to learn the trade of goldsmithing. She worked on the book during her goldsmithing education, thereby learning the work process at the same time and making it possible to translate through her own experiences with the studies and practical work.

Mr. Wönne, whose father is from England, is also a teacher and colleague of mine in goldsmithing and therefore has a thorough knowledge of the contents of the book already.

Ms. Selby and Mr. Wönne worked hard in a combined effort to provide a thorough translation.

I thank them greatly for their help on this book.

I would also like to thank my wife, Doris Schulz-Wahle, for her help with the technical drawings.

In addition, I thank my students who designed and made the shown workpieces.

Table of Contents

This book has been translated from German to English.

All measurements are given in millimeters in keeping with the original edition.

Threading details are given in the metric system.

The number after the „M“ gives the diameter of the thread rod.

Should a conversion be needed:
1cm = 10mm = 0.3937in

1.

TANGRAM

A Tangram is a flat puzzle from which hundreds of possible pictures can be made.

New tools and supports:

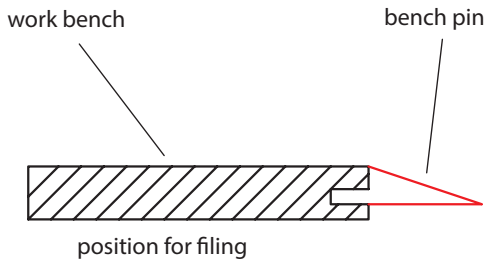
Hand file (W10a)
Steel square (W56a)
45° Steel rule(W56b)
Adjustable angle (W56c)
Scriber (W2)
Jeweler's saw (W37a)
Jeweler's saw blades (W37b)
Bench pin (W11)
Sandpaper (W42)
Work brush (W7)

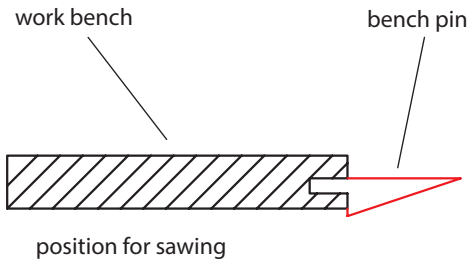
Materials:

Brass sheet
61mm x 61mm x 1mm
(1.2-1.5mm thickness is preferable as right angles are easier to check by eye)

Instructions:

To begin, the hand file with the roughest grain is used to file one side of the brass sheet to a straight edge. The hand file is normally held with the right hand on the wooden handle (which should not be longer than 80mm), the pointer finger of the right hand on the actual file for support. The left hand holds the brass sheet at a right angle to the bench pin (W11), which is fastened in the workbench with the slanted side upwards. Lefthanders use the same positions with opposite hands.





2.

Marking, Sawing, Drilling, and Cutting Exercise

New tools and supports:

Block iron (W6)
Center-punch (W16)
Chasing hammer (W14d)
Compass (W3)
0.5 and 1.5mm drill bits (W5)
Vertical drill press (W52)
Ball-shaped bur, 5mm (W12)
Hanging flexible shaft (W15)

Materials:

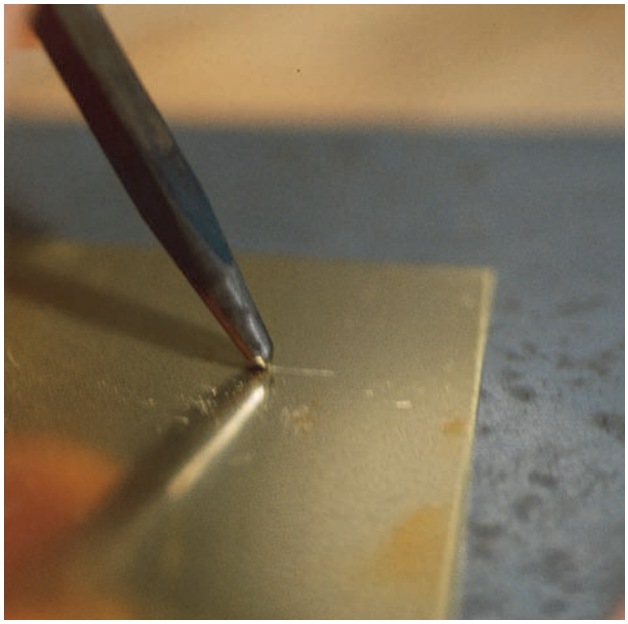
Square brass sheet, 2mm thick
Measurement identical to that of the tangram

Introduction:
First, an interesting design should be thought out and drawn on paper. This surface should be made up of straight lines and sharp angles. Interception lines should stop before the intercepting points. At these crossing points, a 1.5mm hole should be drilled and then cut with a ball shaped bur. The lines should stop 3mm before reaching the sides of the square.

Instructions:

After completing the square, the design should be carefully transferred onto the brass plate. The lines should be lightly marked.

The crossing points should then be lightly marked with the center-punch.
The center-punch, held in the left hand, should be at a slant on the cross points.
It is important to slant the center-punch in order to make sure that it is positioned exactly on the intercepting points. The center-punch is then held at a right angle to the plate. The ring finger of the left hand can be used as support against the center-punch tip and the brass plate.

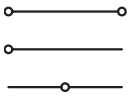


The end of the center-punch is hit lightly with the chasing hammer (W14d).
A block iron (W6) should always be used as a base underneath to prevent any deformation.

A distance of 3mm is then measured out on the compass with a ruler. One leg of the compass is placed at zero and the other leg extended to 3mm by turning the adjustment screw. The compass is then placed with one leg on the marked point, and used to lightly mark off the lines at a 3mm distance. Once done correctly, the lines can be more visibly marked.

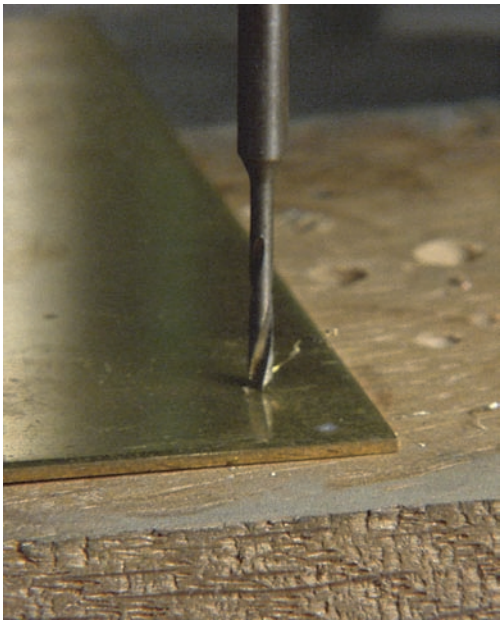
punched points marked

Each line also requires a center-punched mark. From this indentation, a 0.5mm drill (W5) can be used to make a hole for the saw blade to pass through. It should be taken into account where the hole on the line is most optically pleasing.

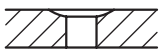


line drilling possibilities

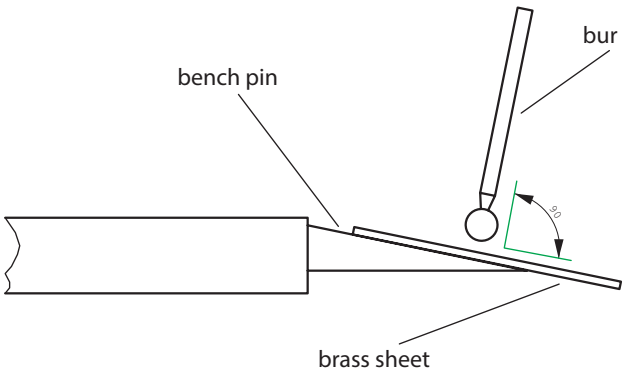
A vertical drill press (W52) is used for the drilling process. The 0.5mm drill is tightened into the three-jawed chuck, and a flat piece of wood is placed on the table of the machine, underneath the brass work piece. The drill must go directly into the center-punched marks, allowing the drill to bore through using only light pressure. Once aligned, the machine should be turned on and the drill lowered into the marks. The drill should be moved up and down when working with thicker material to remove the bore chips. The drill bit should be continuously oiled throughout drilling to keep it cool.



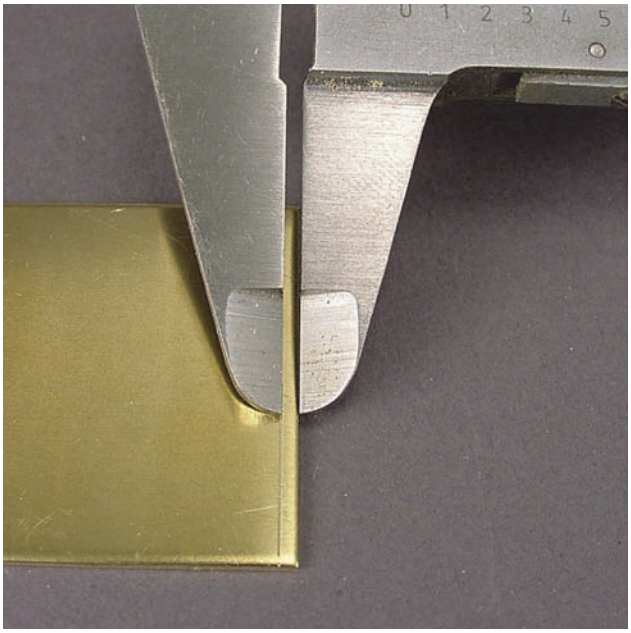
The drilled holes at the cross points of the lines are then enlarged with a 1.5mm drill, and the opening further enlarged with a ball-shaped bur (W12).



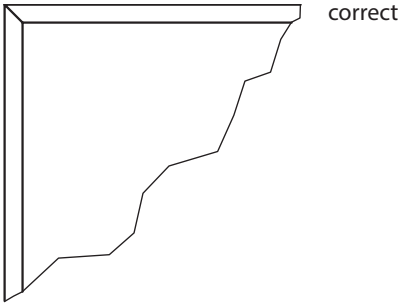
The ball-shaped bur is first tightened into the handpiece of the hanging flexible shaft (W15). The brass sheet is then placed on the slanted side of the bench pin, and the bur set exactly in the middle of the first of the holes to have enlarged openings.The foot pedal of the flexible shaft is used to slowly cut the hole, making sure that the bur stays at a right angle to the sheet. All enlarged holes should be cut to the same depth.



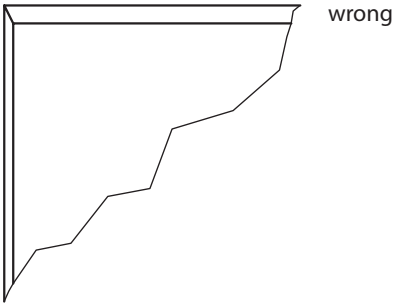
The marked lines are then sawed, at best beginning with the shortest line. The jeweler's saw is opened at the top with the wing nut bolt so that the saw blade can pass through the hole and be re-tightened in the saw. Sawing should follow the marked lines exactly. It is also important to make sure that the sawing is precisely ended where marked.



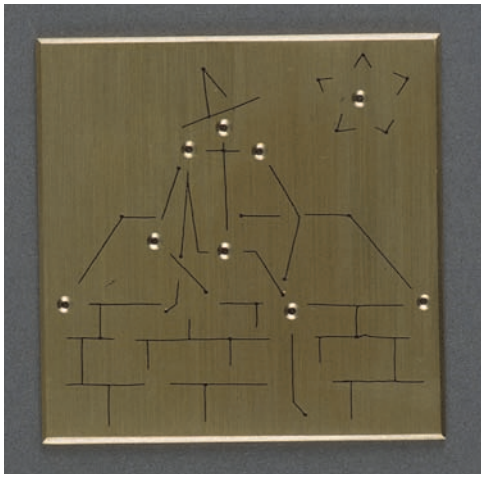
Using the vernier caliper, a 1mm distance is marked from the edges and drawn along all 4 sides on the surface of the brass plate. A facet of 45° should be filed from the edge up to this line, on each side. The plate is then held at a 45° angle against the bench pin with the large flat file No. 5 filing level over the edge.



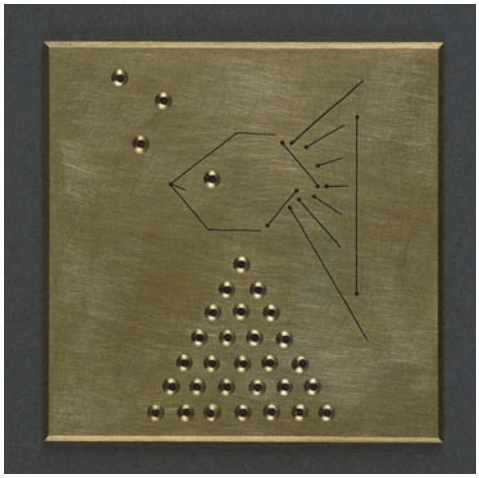
The corners where the bevelled sides meet are telltale of whether the angles of the bevelling are the same or not.

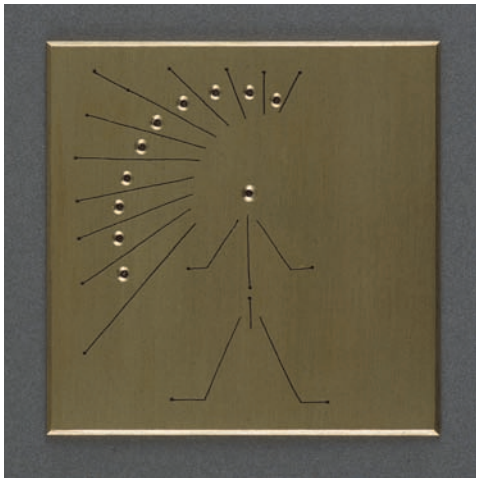


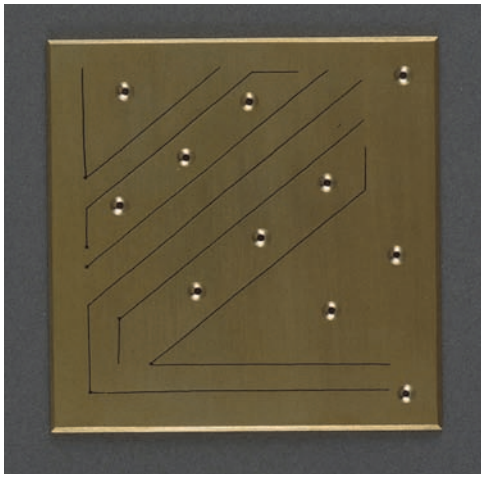
The last step is to sand both sides.



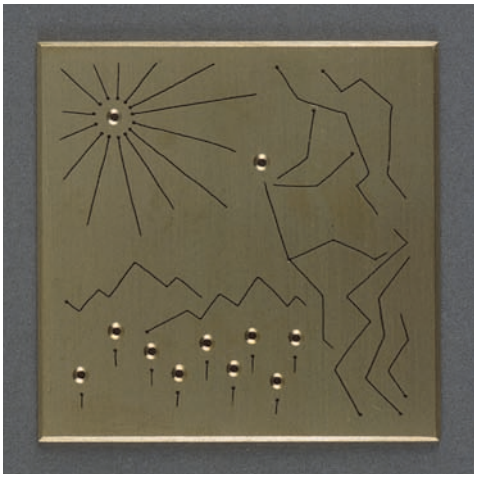
Anne Könen







Leo Lang



Help for Technical Drawing

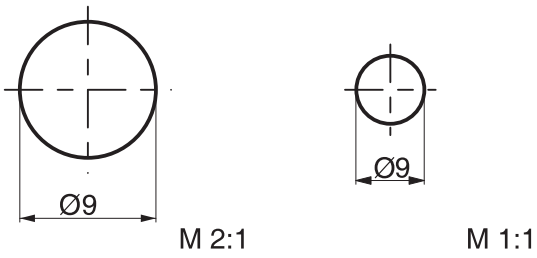
Work pieces are drawn out exactly so that every important detail can be seen. The relationship between the measurements of the drawing to the actual measurements of the work piece is called the scale.

Normal Scale:

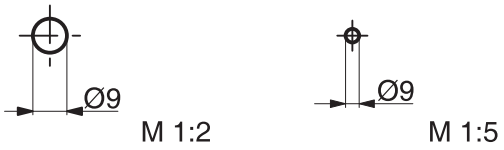
Scale	1 Drawing	:	1 Work piece

Scaling up: x:1 2:1
5:1
10:1
.....

Scaling down: 1:x 1:2
1:5
1:10
.....

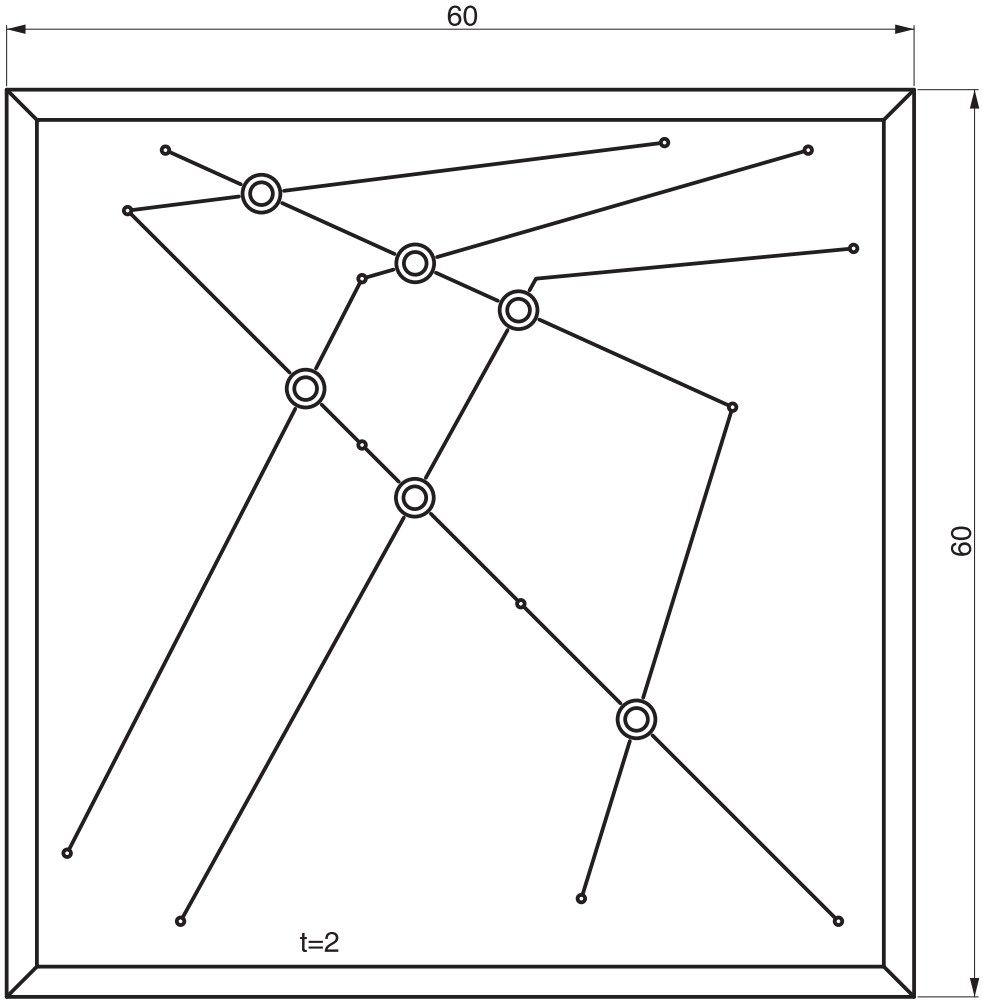


M 2:1 M 1:1



M 1:2 M 1:5

The scale is shown in the text box at the bottom of the drawing. When more than one scale in the drawing is used, the main scale should be written in the text box and the additional scales written beside the detail drawings.
The actual measurements are always used on the drawing, regardless of the scale to which they are drawn.



MARKING, SAWING EXERCISE M2:1

BRASS

2

Notes

26.

Hollow Ring

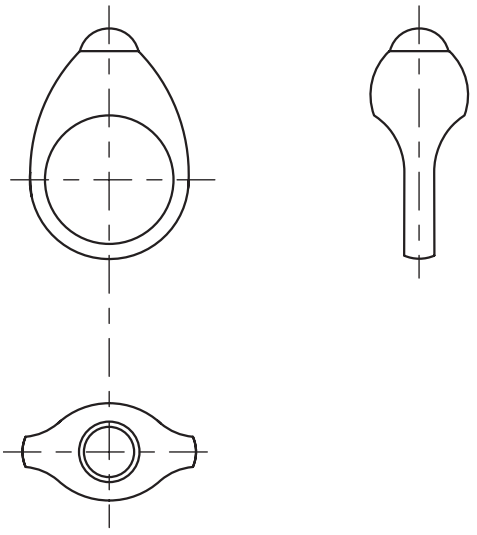
New tools and materials:

None

Materials:

Silver sheet, 1mm thick, measured to fit template
Silver sheet, 1mm thick, length to fit round stone

Introduction:
The following instructions explain how to make a smooth, hollow ring in which a round gemstone is set. The ring is hollow so as to keep material costs down, as well as keeping the ring from becoming too heavy.



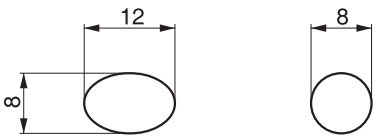
Instructions:

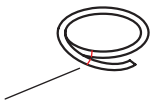
First, the ring size must be calculated. It is best to use the wider ring gauge for measuring the desired finger, as the finished ring width tends to be somewhat large.

Instructions for setting an oval gemstone:
The oval gemstone must first be measured to get the circumference of the setting. The gemstone setting should be 1mm thick, 0.6mm are under the stone.

The following formula is then used:

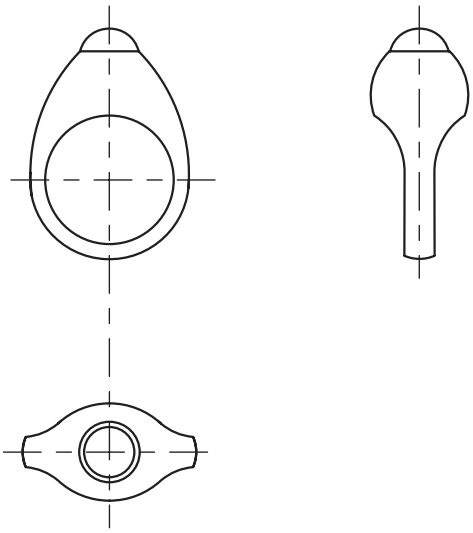
Smaller stone diameter + 0.8mm - 1mm = neutral axis.
Larger stone diameter + 0.8mm - 1mm = neutral axis.
These two diameters are then added and divided by 2. The result is the diameter of the setting, which is then multiplied by 3.14 (π). This approximate measurement is used for the length of the strip of metal used for the setting.





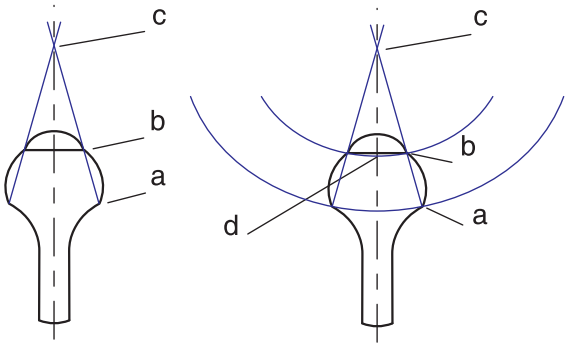
sawed, soldered

The equation is somewhat a rule of thumb; longer oval gemstones, for instance, may have imprecise results. In theory, a slightly longer strip of metal for the setting can be used and bent so that the stone can be laid on the form and, when the outer measurement is correct, the strip cut to the required length and soldered. After the two decisive measurements of the ring are determined, the orthographic projection with the correct proportions should be made.

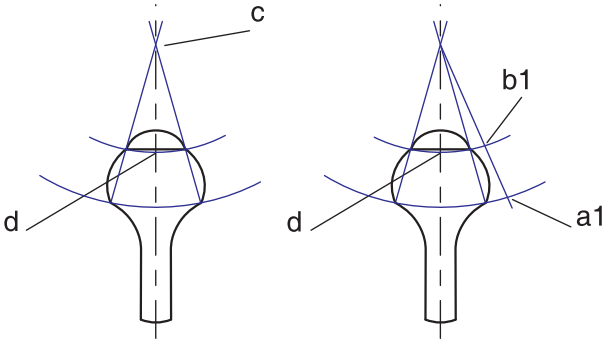


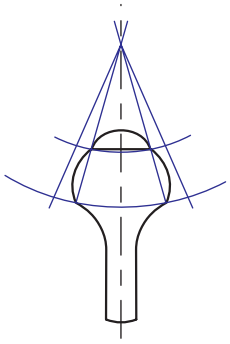
<u>The following example is used to make a ring with a round gemstone:</u>

The ring measurements are calculated using an orthographic drawing. On the side view, the middle line is drawn out, with extra length going up over the stone. A line is then drawn from point a through point b up to where it intersects with the middle line, creating point c. A compass is then used to draw curved lines through the a and b points, with the compass needle on point c.

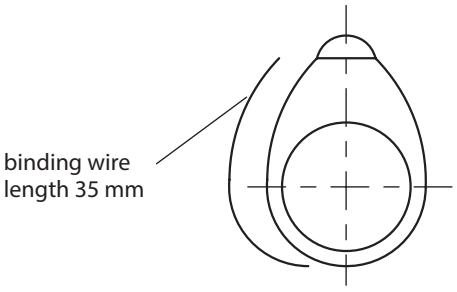


Point d is where the curved line from point b intersects with the middle line. A fourth of the calculated circumference of the stone is then measured out from point d, through point b, to create point b1. Another line is then drawn down from point c, through point b1, to the curved a line where point a1 is made at the intersection. The result is mirrored and drawn on the left side.

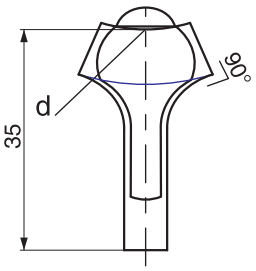




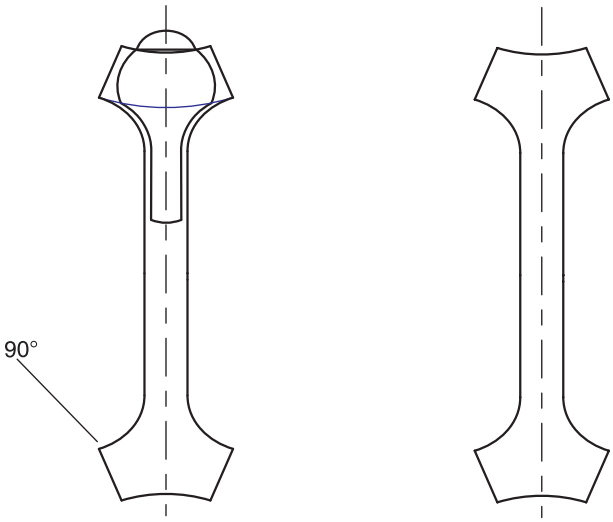
The front view of the ring is measured with a piece of binding wire taken from the edge of the stone setting and curved around the ring template to the middle line.



This measurement is then transferred from point d to the bottom of the template. This is half the length of the ring template. Up to this point, an additional 1mm is added to the width of the ring, because the sheet becomes smaller due to bending. It is also important that the curved line meets the a1 point at a right angle.



This template form is then mirrored to create the entire ring template. For oval stones, the ring head must be a little bit higher.



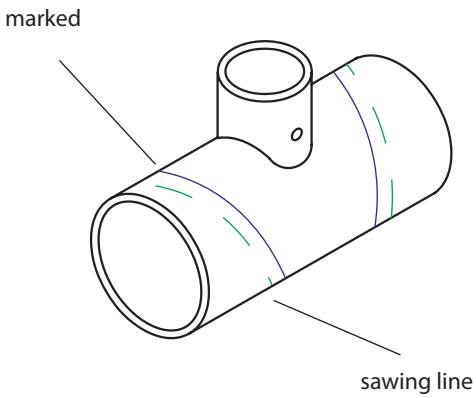
A thin copper sheet is cut out in the shape of the template, bent together with the half-round pliers, and soldered at the head of the ring. The "ring" may then be practiced on with all methods of dapping punches on wood or with the dapping punches (with vise caps!) in a bench vise in order to create the correct form. Once this form is achieved, the template is sawed back apart at the soldering seams and hammered flat with the plastic hammer.

This form can now be compared with the template. If some differences occur, it is possible to work with a compromise of the two patterns, which is drawn on the silver sheet. The ring is now shaped the same way as the copper model until it is symmetrical, with an even surface. The ring mandrel can help to check and correct the roundness of the ring, and the shape worked on through flattening or hollow hammering with dapping punches. The ring shaft for the finger can then be made with a 0.6mm thick silver sheet. It is made to fit the inner circumference of the hollowed out ring form, and filed so that it snugly fits through.

1mm holes are drilled on the longer sides of the setting so that the hollow area of the ring is not completely sealed off during soldering. The soldered seam of the ring shaft should be as short as possible, which is dependent on the type of setting, whether the base of the setting remains closed (seam at base of ring shaft) or open (seam at head of shaft).

adjusted setting

For an open setting, the ring shaft is drilled through at the base of the setting and finished off with a bur or file. The outer shaped part of the ring is then slid onto the finger tube whereupon both ends of the tube are sawed off to within 1mm of the outer ring form.



The gemstone setting must then be adjusted to fit perfectly through the "ring-head" of the outer form, and sit on the band. The underside of the setting must be filed with a curve that sits perfectly on the band. One way of making this easier is to put emery paper on the shaft of a dapping punch with the same diameter as the ring band and sanding the setting directly on the sandpaper/shaft to get the identical curvature of the ring.

The ring band is then soldered to the outer ring form with liberal amounts of solder, followed by soldering on the outer ring form at the setting opening (also with liberal amounts of solder). The height of the setting is then decided and adjusted through sawing and filing. The entire ring is then filed and finished. The last step is to stamp the ring, very carefully, taking into account that the ring is hollow.

Here are some examples of hollow rings.

Andrea Blaschke

Stephan Hübenthal

Michael Maly

Antje Bott

Eva Häckel

Nele Reinders

Dorothee Schäfer

Notes

27.

Hollow Cuff
with countersunk hinge and ...

New tools and supports:

Bracelet gauge (W4)
Jig vise (W38)
Mechanical pencil graphite (S12)
Ø 0.9mm or 1.2mm

Materials:

Silver sheet 230mm x 50mm x 0.8mm
Silver sheet 30mm x 30mm x 1mm
Silver sheet 25mm x 10mm x 0.6mm
Silver sheet 35mm x 20mm x 0.7mm
Silver tube outer Ø 4mm, inner Ø 3.2mm
Silber tube outer Ø 3.2mm inner Ø 0.9mm or 1.2mm
Silver wire rolled profile 4mm x 4mm x 170mm

Introduction:
An oval, hollow arm cuff with a hinge is made in this chapter. The countersunk hinge has the advantage of being practically unnoticeable when the cuff is closed. The width of the cuff can be varied, for which the required amount of material must be adjusted accordingly. The cuff here has a width between 20mm and 22mm.

Instructions:

The size of the cuff must first be measured, done best with a metal bracelet gauge (W4). The inner-measurement of the cuff is found, after which the 50mm wide sheet can be halved lengthways.

Worktools

1 Pickle Pot

For pickling in goldsmithing, one can find a modern pickle pot made specifically for the trade. This machine is especially good as it remains at the correct temperature, helping the pickling process to go faster. The outer form of the machine is made of an acid-tight plastic with an internal heating system. The lid has an integrated handle, as well as a ceramic sieve in which the jewelry pieces are placed. When the lid is closed, the sieve with the jewelry is submerged in the pickling liquid. When the pickling is complete, the lid is lifted and the sieve lets all extra solution drip out.

Jewelry pieces can be run under water while still in the sieve, without requiring them to be directly removed with tweezers. Larger pieces that do not fit in the machine can be pickeled over a burner. Iron tweezers and skin should never come into contact with the pickling solution.

2 Scriber

The scriber is used to inscribe lines and crossed points, usually for sawing and drilling. It is normally made from steel, with an extra hardened point at one end. The point of the scriber should be cut to a 10° angle. In between use, a piece of cork can be put over the point so that it does not cause injury or become dull.
The opposite end of the scriber is a burnisher, good for pressure-polishing on small surfaces.

3 Scribing Compass / Caliper Dividers

The scribing compass is used to lightly inscribe circles, curved lines and measures. It comes into play as a quick and precise tool for goldsmiths.
The screwing mechanism needs only to be turned, applying light pressure on one leg of the compass in order to meet the exact measurement needed. The integrated spring holds the legs in place at the correct measurement.
There are two types of scribing points that can be used: one is the points that come with the compass, which can easily be sharpened, or specially hardened points that can only be cut with a diamond-hard tool. The scribing points should be well handled and remain clean, as well as kept safe with corks on the ends.

4 Bracelet Gauge

There are two ways a bracelet can be measured in the workshop:

4a)

A Steel band with the bracelet measurement scale and holes 5mm apart in the middle of the cuff. A small pin at the end of the band is used to close the fastening while on the wrist so that the correct length for a specific wrist can the be measured. This instrument also has the advantage of being flexible enough to be bent in the required form (oval, round) creating an exact measurement.

4b)

A bracelet gauge made of 4 straight wires that can each be shifted in two directions. It is ideal for measuring the right angles of a rectangular or square cuff.

5 Drill Bit

The spiral drill bit is the most commonly found drill bit in the workshop today. These spiral drill bits have a standard shaft circumference of 2.34mm, made so that the drills can fit into the flexible shaft. Some drills are also made so that the cutting spiral extends further, with a shaft of the same diameter. These drills can only be used with fitting shaft holder.

The drill bit should always be worked into the grain of the piece being drilled into. It must also be cooled during the drilling process which can be done with coolant, oil, or even spit when working with thinner drill bits. If the drill bit only forms a small recess with buildup, then the drill bit has probably become dull.

The best way to sharpen the drilled end of the bit is by placing a sharpening stone on the work table and, holding the drill bit tightly in one hand with the elbow on the table, rubbing the bit with light pressure back and forth over the sharpening stone. This should be done on both sides of the point.

The hand and elbow work together as a stable unit. It is also important that the middle point does not alter from its original position. The angle of the point should be approximatly 118° and the back, cutting angle should be at a 6-8° slant.

Earlier, the "eureka" and "pointed drill bits" were often used. These are used seldom in today's workshop. The "pointed drill bit" is mostly used in a drillstock, and is cut in two directions because it rotates back and forth, cutting in both directions.

6 Planishing Iron / Bench Block / Block Iron

The planishing iron is made from a heavy piece of steel with an extra hardened surface, specially cut and polished to be evenly flat; it is standard in the workshop.

When used, the iron should be placed on a piece of felt or leather so that it can absorb the hits going into it. Smithing, rivet work, and straightening work can all be done on the planishing iron, but the work can only have a good result if the surface of the planishing iron remains immaculate.
It may not be directly hammered upon since both the iron and the hammer can be damaged. A significant amount of work can be spared if the planishing iron is kept free of nicks in good, polished condition.

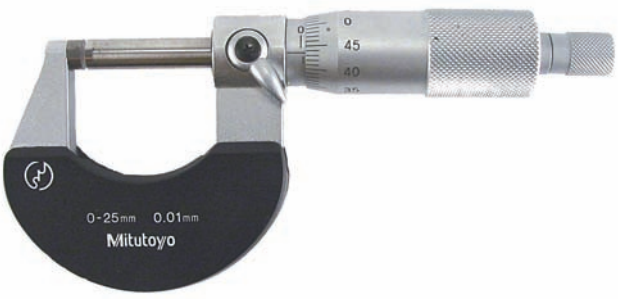
7 Work brush

The work brush is used to brush off the work piece, as well as to brush away the residual filed metal from the bench pin and table surface, into the jewelers leather board. The leftover metal can then be brushed into the copper bowl and placed in its metal container.

8 Micrometer

The micrometer is a precise measuring tool. It can measure up to 1/100th of a mm exactly. The two measuring rods must be clean as the smallest hindrance can throw the measurement off. The frame-measurer should only be operated by the friction screw on the end. This mechanism makes it possible that all measurements can be taken with the same amount of pressure on the measuring spindle.

With the micrometer, one can measure:
-the whole millimeter from above (the line),
-the half-millimeter from below,
-the hundredth of a millimeter on the measuring cylinder.



9 Triangular Scraper

The triangular scraper is used to scratch off the oxidized surface of the solder before soldering. It can also be used for trimming, though improper use can produce small facets on the edges. The scraping function is done by lightly rubbing the instrument over the metal. In this case, the sharp edge of the triangular scraper should not be tilted against the direction in which it is drawn.
As the name states, the triangular scraper is made from three sides which come together in a sharp point, and is hollow to intensify the effect. A special grip for the scraper is made from metal for better use in the goldsmithing workshop. Both ends of the 3-edged piece are pointed. This piece can then be extended in the adjustable grip which works similar to a pin vise . This way, the tool can be adjusted to the optimal length for each project. Resharpening the triangular scraper is also easier when it is extended further out of the grip.

10 Files

10a Flat Files

Files have an material removing effect. The “flat file” consists of a flat edge, mirror, and tang, that is then attached to a wooden handle which should altogether be no longer than 80mm for goldsmith work. The file has a very light convex form from end to end, making it possible to file straight edges. The file length is measured from the top of the file to the beginning of the tang, which should be about 250 mm. The ridges are on the two main surfaces and one side of the file. The courseness of the ridges vary from 0 (very course) to 5 (fine), which is written on the base of the file. The filing end is hardened though the tang remains untempered.
Before using the file, it must be attached to a handle. This can be done two ways:

1. Heating the file.
In this case, the tang is heated with a flame until the point of the file glows red. The end of the tang should not yet become blue, however. The file should then, with the tang end up, be tightened in the vise and the handle hammered on with medium-heavy strokes on its end.

2. Drilling the file
The file handle is drilled with several differently sized drills. The handle is then placed on the tang and soundly hit so that it securely fits on the file.

10b Ring file

This form of file is used specifically for jewelry work. At the end is a gradually curved point, with one side of the file flat and the other in an outwardly curved form used to work the inner curve of a ring.

10c Needle files

These are the most frequently used small files. The handle is continued out from the file in a round, cylindrical shape. There are a variety of cuts (1-5) in different shapes (threesquare, square, round, hand, crossing, joint, warding, barrette, and knife form).

10d Escapement Files

This files are similar to the needle files, only smaller, with a finer cut (5-8). In contrast to the needle files, the escapement files have a square grip so that they can be easily told apart when on the work bench.

10e Joint/Hinge File

These files are available as both flat and rounded. The advantage is that they can file exact, straight edges. The flat files have the cut on the narrow sides and lend themselves by being parallel to file very precise slits. These files have a grading of 0.1mm.
The round hinge files are cylindrically made and also have a grading of 0.1mm.

10f Riffle files

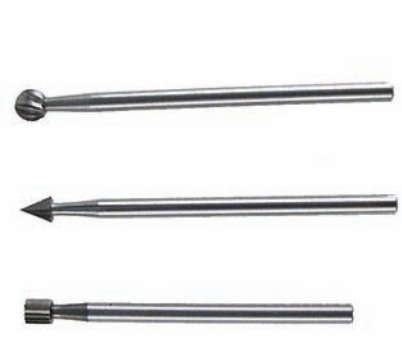
Similar to the needle files, riffle files have curved ends so that difficultly accessible areas can be more easily reached. They are available in a variety of different shapes and cut fineness.

11 Bench Pin

The bench pin is a wedge shaped piece of wood that fits into the slot in the middle of the workbench. Most goldsmith work takes place on the actual bench pin. Fine metal pieces and shavings lost during the production of jewelry pieces can then fall from the bench pin into the jewelers leather board, making it easy to collect the scraps for later use.
The bench pin should, when possible, be screwed with a wing nut into the work bench. A steel plate integrated into the work bench is advantageous here . The bench pin can be easily used for filing with the slanted side facing up or for sawing with the flat side facing up. In the case that a work bench is used by different people at different times, one should always have their own bench pin.

12 Bur

Burs are usually used with the flexible shaft. The have a shaft diameter of 2.34mm and are available in a wide variety of sizes and forms. Different burs can be used depending on the project and personal preference . It is important to have the correct rotation calculation for the specific work being done.



For machine work, the number of teeth on the bur and its size are used to calculate the rotations count and time needed for the distance milled. Practice and a good feel for the tools are best for finding the correct rpm needed for each bur.

13 Die Threading and Tapping

13a Circular Die Stock and Die

Apart from a few exceptions, only metric screws (cutting angle of 60°) are used.
In this case, the grade of each thread is standardized so that the screw with the same diameter always fits together. The circular die cuts the outer screw thread on the rod. Good circular dies are made from high quality steel and are available in open and closed forms.

13b Screw Taps Hand Taps

Screw taps are used to drill the inner hole part of the screwing mechanism. They are made from high quality steel and have a triangular base . The pre-cutter has approximately 50% of the screw depth, the middle-cutter 30%, and the final-cutter with 20%. The pre-cutter has a ring engraved around the shaft so that it can be identified, the middle-cutter two rings, and the final-cutter has none. The screw taps have a long incline and can easily break when incorrectly screwed.
The non-cutting end has 4 edges so that it can fit into the tap wrench.

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