THE HINGE

A hinge is an articulated construction used as a joining device. For purposes of discussion, we speak here of a hinge as a separate entity though in fact in jewelry it is also often an integral part of the piece. The diagram shows a typical hinge as a separate unit. It consists of two side flaps or leaves in their simplest form, as flat rectangles, but they may be curved or in any ornamental shape. Attached to the flaps are cylindrical forms variously called lugs, cheniers, or knuckles, that match in both external and internal diameter, and are lined up with each other. The lugs are called knuckles because they act in the same way as those finger joints of the hand. In jewelry, lugs are usually made of short sections of tubing, with exactly squared ends, but they can also be made of a tube shape made of a spiral of wire, or they can be an integral lug made of a cylindrically bent extension of the metal used for the flap. A hinge has a minimum of two, but usually is more stable with three or more lugs attached alternately to the two flaps. In the diagram, two are attached to the left flap and one to the right. They must be lined up with each other to allow the passage of a retaining pin that holds the hinge parts together. The flaps rotate around the pin. The amount of movement may be minimal to an angle of 180° (depending on where the restraining flange or stop device is placed), or up to a full 360°, called a turnover hinge (in which the flaps come completely flat on each side). The hinge can be completely invisible and used to articulate a part of the design concept. If flaps are used, they can be soldered to the back of the piece so that only the lugs show, or they can be visible and highly decorated.

CONSTRUCTING A HINGE

Measure the total length for the lugs or knuckles. Divide this measurement into a minimum of three equal parts, the most common number used. Two-lug hinges are sometimes used when each of them is long enough, but they are not as strong or as stable as a three-lug hinge. Hinges with more than three lugs are common. An odd number of lugs keeps the pin in line as both ends are held by the same side or flap, and this prevents the pin from bending.

When cutting tubing, to assure squared ends, avoid waste, and unnecessary work, some device to hold the tube perpendicular to the cut is needed as this can rarely be done free-hand with accuracy. A simple device is a hardwood block with squared ends and a V-shaped lengthwise groove perpendicular to its ends. This can be easily made, and is useful in guiding the saw to make accurate, true cuts and it also serves as a template when finishing a cut end. Joint tools are also used to hold tubing and wire while it is cut.

Mark and cut the lugs one at a time from seamless or seamless tubing, on each of them allowing a fraction more than is needed for trimming and trueing. They are marked and cut separately because there is some loss of metal in the cutting groove and inaccuracies can occur. Place the tube in the V-groove of the wood block and hold it down firmly with the fingers, cut through the tube, holding the saw blade close to the block end. When sawing tubing, make an initial groove, start slowly, and use little pressure before arriving at midway, then increase the pressure.

To assure a close-fitting hinge, the lug ends must be finished at a 90° angle to the tube axis. After the tube is sawed through, finish and square the end by placing it flush with the block end, and while holding it firmly, file or stone the end true. The tube can also be placed between two pieces of hardwood with a groove to hold the tube in place, then clamped together. Measure the tube from this finished end, and again allowing a fraction for trimming and trueing, cut off the lug and finish its ends in the same way. Do the same for the others needed.

To check the accuracy of fit and total length, thread all lugs on a straight iron or steel wire drift pin having the same gauge thickness as the metal pin used later. Allowing two or more holes in an object by inserting a pin is termed drifting. This same wire drift pin is used during soldering, as described below. Assembled, the lugs appear as they will be after soldering. Defects such as space between lugs due to inaccurate end squaring can be seen and corrected. Lugs that do not fit closely together allow an undesirable looseness and eccentric, lengthwise movement of the hinge.
LUG PLACEMENT

There are various ways of placing the lugs depending on whether they are to be visible or not. If visible, they are butt ended with the flaps. If invisible, the flap or sheet metal edge must be either chamfered or cut off at the corners to an angle or a rounded, concave depression must be made to accommodate the lugs as illustrated in the diagrams in this section.

SOLDERING THE LUGS

The lugs are soldered in alternating order to the opposite flaps. Place them in position, assembled on the iron driftpin wire mentioned. Iron or steel wire is used in the soldering operation because it has a higher melting temperature than the precious and nonferrous metals, therefore there is a less chance of the solder fusing to it. For future reference, mark the position of each lug location on the flap with a scribe.

The biggest problem in hinge making is to prevent the flow of solder to unwanted places which can cause the hinge to freeze. Remove the iron driftpin, coat it with a solder inhibitor such as yellow ochre, and allow this to dry. Clean each lug and carefully coat each end only with yellow ochre and allow it to dry. Coat the flaps with flux and dry. The reason for drying in advance is to eliminate all mechanically combined liquid which can cause the yellow ochre to flow to unwanted places and thus make complications by preventing the flow of solder to where it is wanted.

Reassemble the lugs on the iron driftpin and place them according to the marked position in contact with the flaps which are now resting on a soldering surface. Leave the iron driftpin inside during soldering to assure the correct alignment of the lugs by holding them in place. If seamed tubing is used for lugs, place the seam in contact with the flap so it is soldered closed at the time of joining. To increase the contact area between the lug and the flap, before placing the lugs, while they are on the iron pin, run a file down their length to flatten one side. Put this flat side in contact with the flaps.

Dip a small minimal snippet of hard solder in flux, and dry it. Place one of these snippets in contact with each lug and flap, on the side to which it is to be joined. Avoid using too large a piece of solder which can flood the joint and freeze the hinge. With a small-size torch tip and a soft flame, slowly heat the metal to drive off any moisture in the assembly, and when all evidence of moisture disappears, add more air to point the flame. Concentrate the heat on the solder, and remove the flame as soon as the solder flows. Do not unnecessarily prolong the heat.

Allow the hinge to cool. While the pin is still in the lugs, test the movement of the hinge to see that it is operative and that the lugs have been joined. If a lug comes loose, reflux the joint and repeat the heating. If solder flows inside the lug, remove it with a reamer of appropriate size.

Before pickling, remove the iron driftpin with pliers, and scrub off the yellow ochre to avoid contaminating the pickle. Again check each lug to see if it is held securely. Small adjustments can be made with a file if needed. Should the hinge freeze with solder, it must be heated again to solder flow temperature, and the frozen parts removed. All solder is then filed away and the process repeated.
Hinge Considerations

Hinge types and their suitability will vary according to the application. A number of hinge types will be addressed in this section. Two of the most common kinds, a butt hinge and a hinge installed into a bearing, begin the section with step-by-step installation instructions and then it continues with a discussion of other types of hinges. The convention with most hinges is that one always uses an odd number of knuckles and that they are of equal lengths.

The hinge can be inset to various depths into the plates it hinges. This decision concerns design intentions, stop positions, structural strength requirements and hinged parts position.

Hinge Pins

The hinge pin is the rod that connects the different parts of a hinge. It is the axis point in the tubes of a hinge, around which the tubes rotate and pivot. In general, a hinge pin needs to be as hard as you can get it and to be polished and move smoothly within the rotator knuckles. My usual favorite is a force-fit one. This section deals with some important hinge pin considerations and a number of generic hinge pin types.

A hinge pin must be hard enough to resist wear over long use and yet have some torque to it so as to resist failure. Such failure is usually due to different parts of the pin being gripped by friction within the tubes of the hinge. This twists the pin slightly back and forth during use and eventually it snaps—just as occurs when bending a wire back and forth at the same spot.

Always Start a Hinge Very Tightly

Remember that our metals are soft, mushy and rather unsuitable for building mechanisms such as hinges. Therefore, whenever you build a hinge, build it very tightly. You will find that in six months it will be moving very freely. If you start with a hinge that has any looseness to it then it is likely to be floppy and sloppily loose down the road.
BASIC TOOLS FOR MAKING HINGES

Basic tools for constructing hinges include a standard goldsmith's kit: pliers (at least two of each kind, box joint is best), saw (3-inch throat), files (#2 cut 6-inch or long double cut, one flat, one half-round), pocket knife, needle files (square, round, half-round, triangular at 20 cm long), flexible shaft, flexible shaft tools (drill bits, burrs and burr sets, finishing tools like buffs, brushes, brass and nickel brushes, emery mandrels, silicon points, felts, etc.), safety equipment (goggles, face shield, hearing protection), a basic bench hammer and a selection of sanding and finishing tools. I like silicon carbide separating disks for a lot of scoring and bending; these are very brittle, black, hard disks, available from dental suppliers and jewelry suppliers. Reamers of various sizes are extremely useful in construction, as are a selection of drill bits, soldering supplies and materials. Measuring and fitting equipment: I recommend having three pairs of dividers—many professionals like to have five near their bench. This is because you often have to repeat measurements, so you set the different dividers to different lengths, lay them out on your bench and use them in sequence. A Vernier caliper is a must, and sometimes a micrometer can be useful as well. A stainless steel rule, and a darning needle for scribe lines and marking things. A thin “Sharpie®” marker can also be useful.

BEVELED TUBE ENDS FOR RIVETED HINGES

It is, however, usually best to bevel the openings of a tube slightly to give the rivet a better purchase in use. A beveled tube end produces a good flush rivet.
OTHER RIVETING METHODS

One can rivet the hinge using hammers, a hammer handpiece, punches, specially adapted pliers, a rotary riveting wheel or equivalent, by balling up the wire ends with a torch—any way of spreading the wire to lock it in place in the hinge counts. Some approaches, like forging the end of the wire out sideways or splitting the end of a wire with a sawblade and peeling each side back, work, but are not particularly functional or attractive unless you are doing a vast production run and speed of installation is important. You may see such rivet ends on tin toys.

![Forged sideways to spread and Split rivets diagrams]

Another single-knuckle hinge may be found on small Native American silver boxes from the Southwest United States. Tubing is soldered to the top of the box and wires are inserted and bent downwards. Their ends are soldered onto the bottom of the box. Because the solder joints are a little distance from the tube, the wires can be tensioned so as to create a “snap” when the lid of the box closes. Because they are often used in multiples, like the pair shown below, they are, in fact, a kind of two-knuckle hinge. A single one can work on a round box.

![Single knuckle hinge used as a pair on a box diagram]

COIL TUBES (WIRE, STRIP)

In the days before drawplates, and still in parts of the world where a drawplate is rare or too expensive to consider buying (such as North Africa and parts of Asia), tubes for hinges are made by winding a coil of jump rings onto a round mandrel and then running solder down the coil, thus obtaining a “tube.” If one uses a strip of sheet metal (rather like a toilet paper tube) or rectangular or square wire instead of a round wire for this, one can obtain a pretty good tube. There may be a time when this is a useful bit of information for you. I recommend the use of hard solder most of the time in soldering operations.

![Coil tubes made of wound jump rings diagram]
SHEET METAL HINGES

Hinges can be constructed from sheet metal strips with holes drilled in them, much like the way certain watch bands are made and door mats are assembled from rubber strips. No tubing is involved and assembly is fairly rapid. The main requirement is that the drilled holes are accurate and that measuring and fitting are well done.