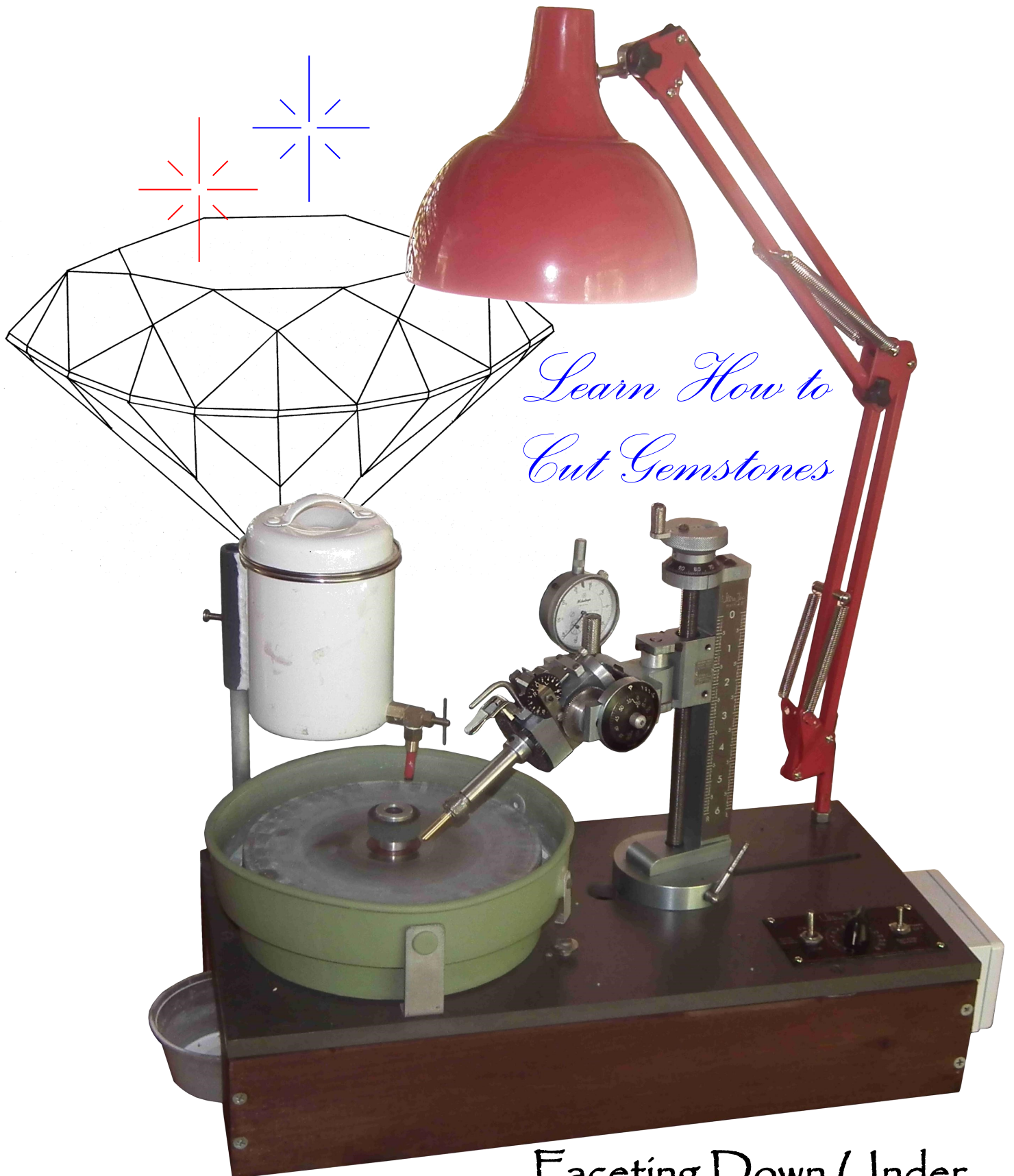


Faceting Made easy

By Trevor Hannam



*Learn How to
Cut Gemstones*

Faceting Down Under

The Beginners Guide On Faceting Gemstones

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4th edition**

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INTRODUCTION

Have you ever read a book filled with so much technical jargon that it leaves you more confused than when you started! I think we have all fallen into this category one time or another.

It is for this reason that this book has been written. I myself found learning from such a book, if not properly illustrated or explained in everyday terms can be very frustrating and discouraging. Unless you can get an instructor to help you, most beginners will just give it up.

This book and associated DVD (if purchased) contains detailed instructions and illustrations in concise patterns on cutting the Standard Brilliant, and gives the individual a working knowledge of all parts of the Faceting Machine.

Books and teachers of faceting often vary in their technique and most still advocate cutting the table first. Times change, and new ways are found to cutting the Standard Brilliant.

This book just presents faceting another way, starting with the pavilion and as you read and learn, you will see the wisdom of this technique.

There is no hard and fast rule in faceting, just the basics and beginners are encouraged to experiment once they have mastered the Standard Brilliant.

I feel this book has presented gem faceting in such a way that any average person can learn quickly, and soon develop their own technique in the art of gem cutting.

Trevor Hannam
2000



ABOUT the AUTHOR

Trevor G. Hannam, born in Wudinna South Australia, moved to Cairns Queensland 1966. Introduced to faceting by Kay & Jimmy Gadd, where he learned to facet with the help of Bob Johnson. Furthered the study of gems by completing a diploma in 'Earth Science', and continued to study the art of 'Gemmology' through kye Jewellers. Member of the 'Cairns Mineral & Lapidary Club Inc.' where he use to teach the art of silver smithing , Gemmology techniques and faceting. Currently Retired.

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CHAPTER 1 - LIGHT & ITS PROPERTIES

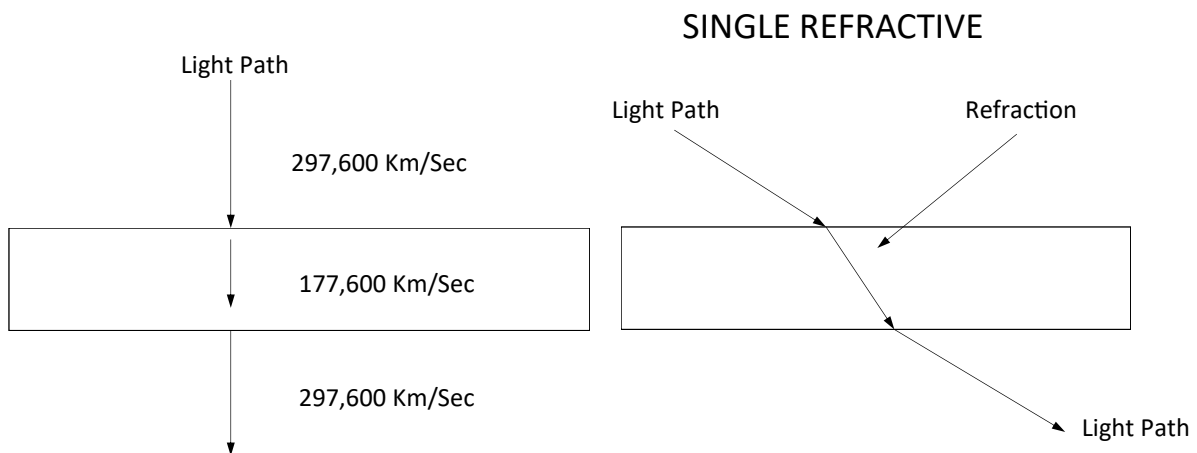
Speed of light Travels through air and space at 297,600 kilometres per second, but as it passes through a solid object, such as a piece of glass, it does two things, slows down and changes direction or bends.

Why does light slow down? Because it's passing through a denser material than air. For example, try driving a car through water. The water is more dense than the air, so we are slowed down by it.

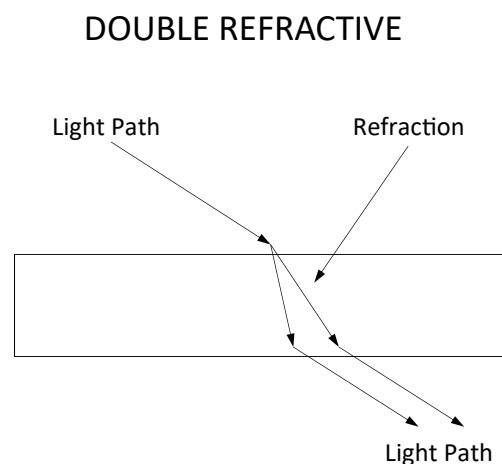
Why does light bend? As light tries to pass through the glass it is pulled due to the sudden reduction of speed, because of the higher density. Lets take for example, that we are driving on a sealed road and up ahead there is a small amount of water on the left hand side of the road. As we hit this water at normal speed, the vehicle is immediately slowed down and pulled to the left. This is exactly what happens when light passes through glass. This phenomenon is known as Refraction and is constant in all gem stones.

REFRACTIVE INDEX

Is the speed of light divided by the speed of light in the mineral concerned

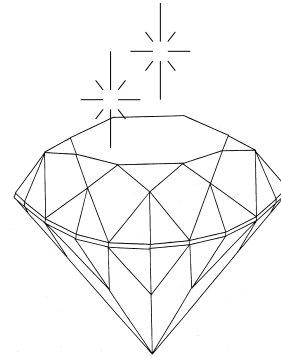
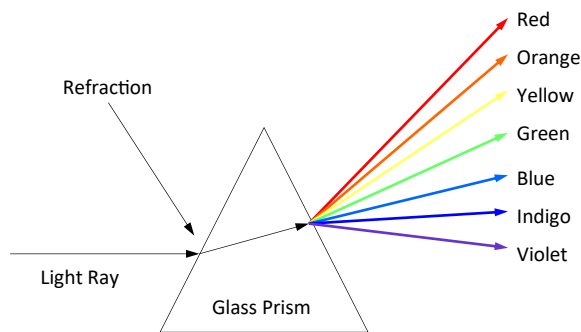


In Calcite Crystals and some other minerals light has the tendency to split into two paths. This is known as Double Refraction.



When a gem is cut properly with angles that are designed for it, the gem will cause light to be internally reflected many times and thence returned through the table to your eyes. It is the internal reflection and refraction which produces the little explosions of colour. The facets actually acting as tiny prisms.

White light breaks down readily if passed through a prism into the colours of a rainbow. As a kid I was taught this as a name; 'Roy G. Biv' - Red, Orange, Yellow, Green, Blue, Indigo and Violet.



THIS PHENOMENA IS KNOWN AS DISPERSION

DOUBLE REFRACTION

Light can be affected in other ways in a crystal. Minerals can either be single refractive or double refractive. In normal single refractive minerals, light behaves in its normal manner, that is, it slows down, refracts and is internally reflected. In double refractive minerals, this however is altered. Light is split up into two paths. This is due to the minerals atomic structure and its having one or two axis's of different lengths..

Calcite is a very good example of double refraction. If you place a piece of clear calcite over some small print, you will clearly see the print doubled, as if you have gone cross eyed.

Original print shows
Up as two sentences.

Calcite Crystal

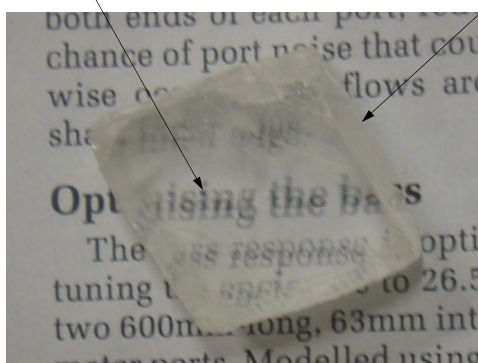


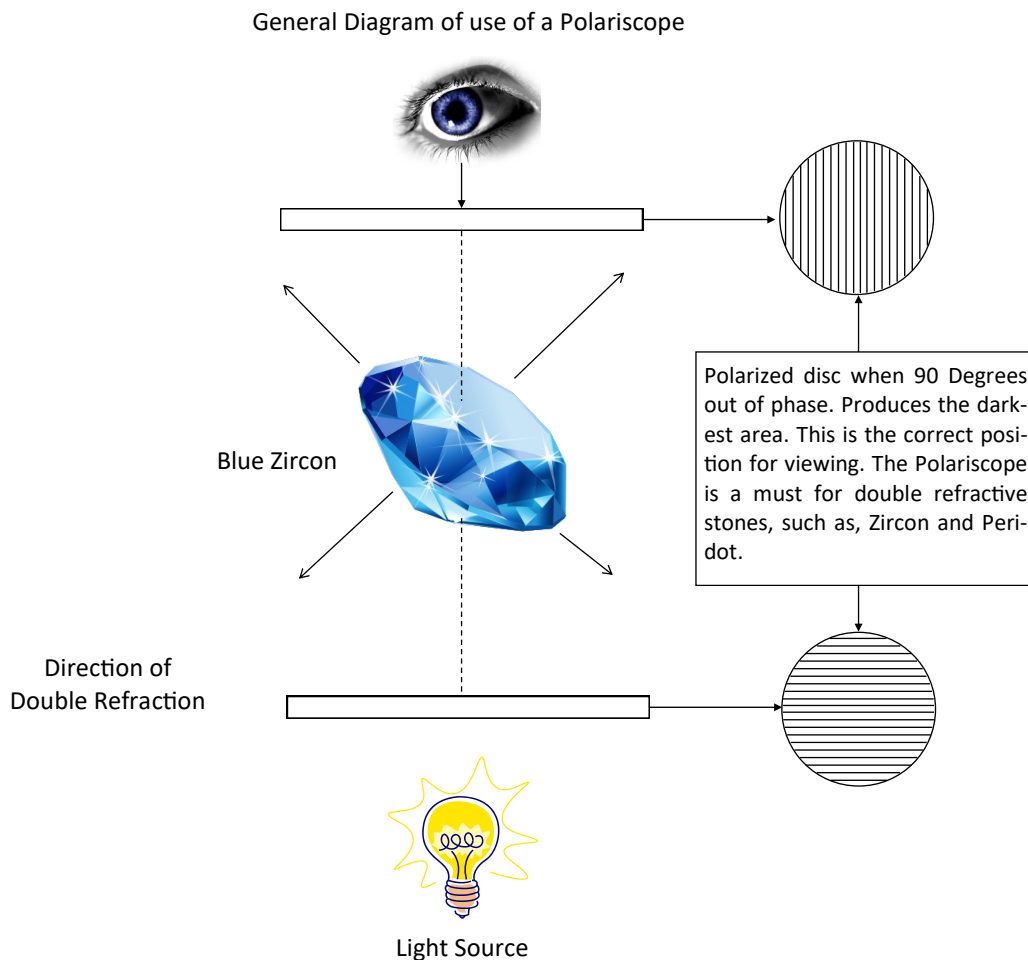
Diagram showing Double Refraction
In a Calcite Crystal

POLARISCOPE

Double refractive minerals can easily be identified by using a Polariscope, which is definitely required by the amateur faceter if he or she is looking for the best optical benefits.

A Polariscope consists of two discs of polarized plastic (or a cheap pair of Polaroid sunglasses) that are separated by a mechanical support. A light source is produced underneath one of the discs. The gem rough is then placed atop of this disc, whilst your eyes are looking through the top disc. The top disc is then turned until it reaches its darkest point. The stone is then turned or rotated in a 360 Degree revolution in all directions until you see the best position of refraction. What you see as the gem is turned is a lightness and darkness of the polarized light. Will be either 2 times for a double refractive stone (known as uniaxial) or 4 times for a stone with a double axis of double refractive stone (Known as biaxial). The axis of the stone or gem rough is the part where the gem turns the least amount of light and dark.

Below is the principal of a Polariscope.

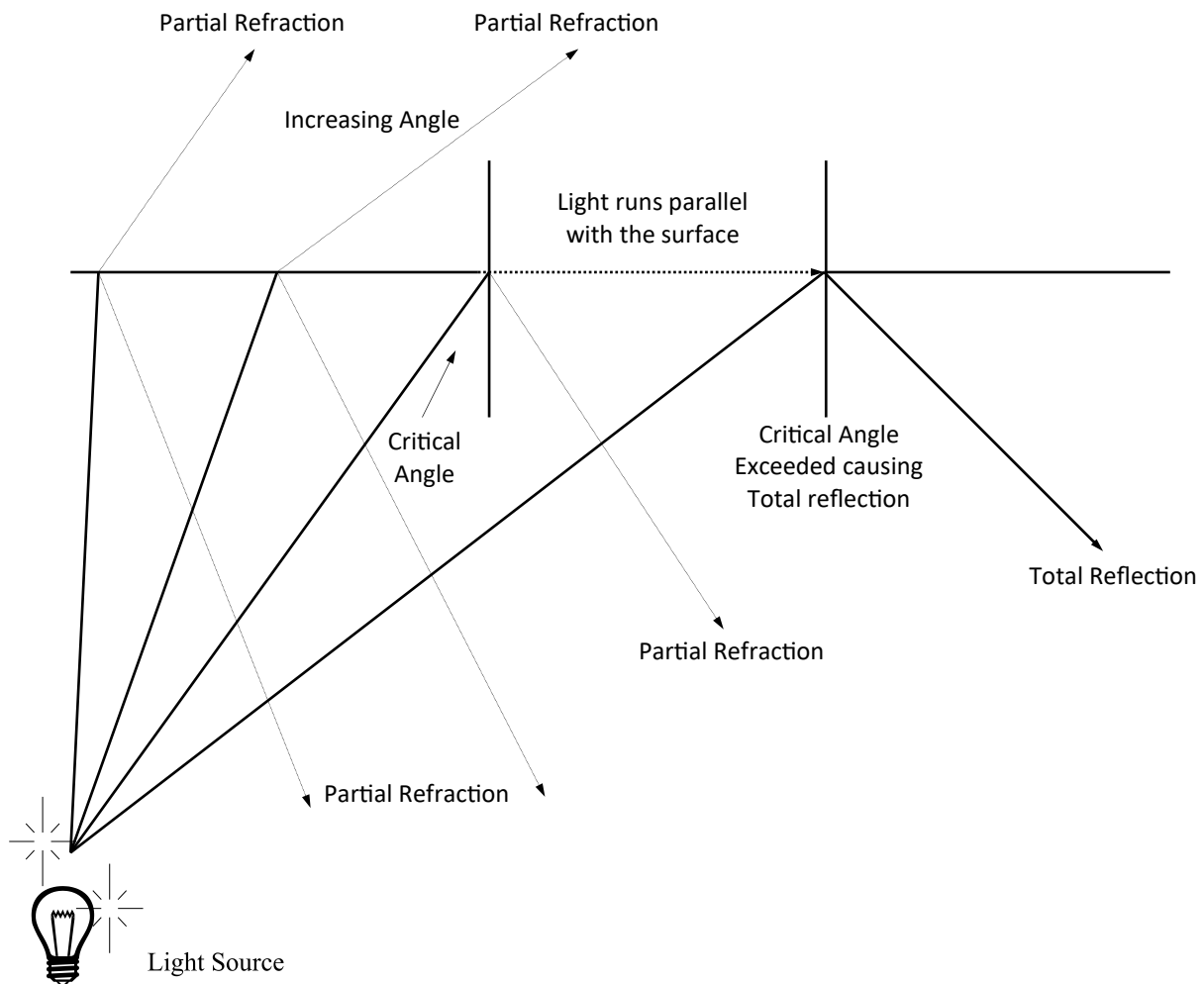


THE CRITICAL ANGLE

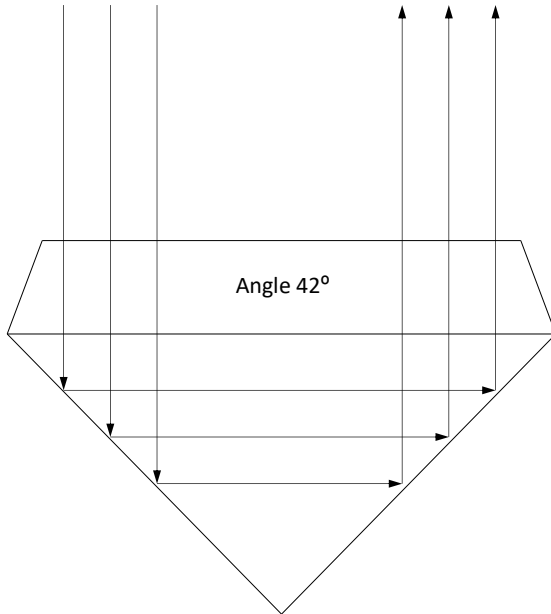
As the angle of light from a source increases to the surface of a gem stone, the angle of refraction will also increase until a point is reached where it will run parallel with the surface of the gem stone. The angle of incidence which causes the light to become parallel to the surface is known as the Critical Angle.

If the angle of light exceeds the critical angle, the light source will become totally reflected. The minerals with a small critical angle will loose less light than ones that have a larger critical angle. This means that gem stones with a smaller critical angle can prolong the internal reflection of light thus producing more sparkle and colour.

WHAT LIGHT DOES WHEN THE ANGLE OF INCIDENCE IS INCREASED



CUTTING OF CORRECT ANGLES AND WHAT CAN HAPPEN IF THE ANGLES ARE NOT CORRECT FOR THE MINERAL CONCERNED

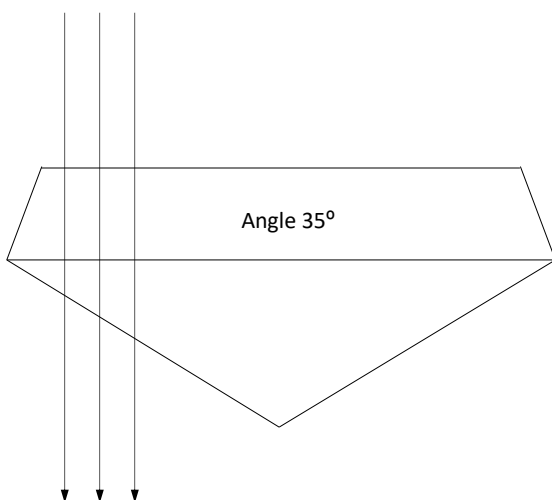
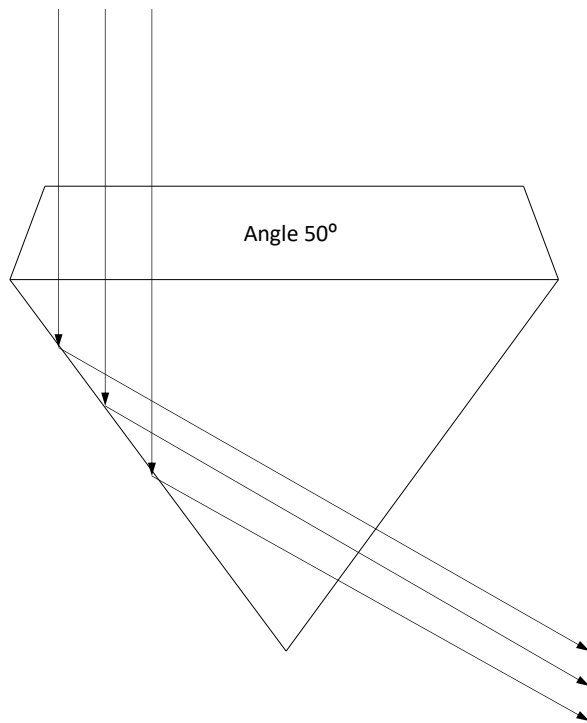


TOPAZ CRITICAL ANGLE 37°
Cut from 39 to 42°

This gem stone has been cut correctly

The angles are correct for the mineral Topaz and has full total reflection which produces those little explosions of colour.

This gemstone has a dark centre and is caused by excessive leakage of light through the pavilion because it has been cut at an excessive angle of 50 Degrees.



This gemstone has what is known as a 'Fish eye' effect, and is indicated by seeing straight through the centre of the gem stone producing a halo appearance around the perimeter. This is caused by cutting the gem stone far to shallow, 35 Degrees.

PLEOCHROISM

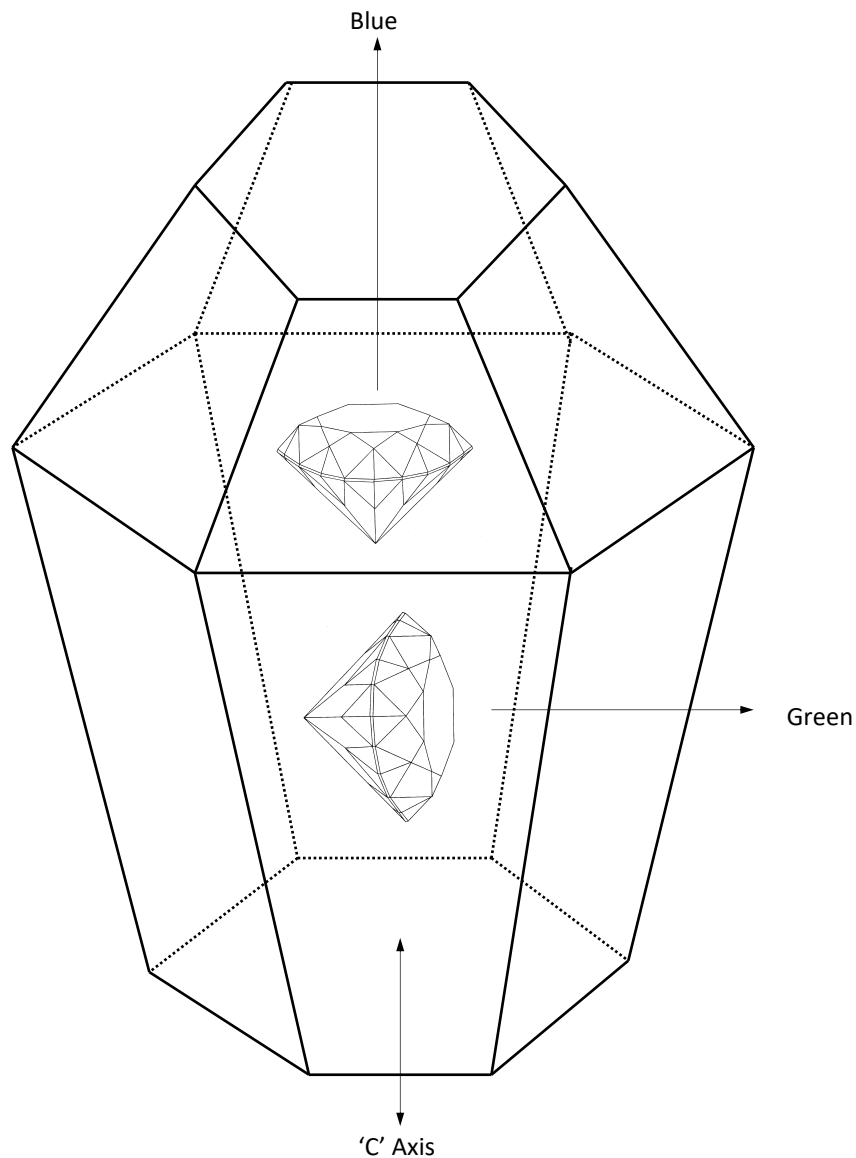
Certain minerals have a colour change which is caused by absorption of light when it passes through different directions in the mineral.

If you turn a gem and see different colours from different directions, the mineral is referred to as being Dichroic. A good example of this would be a sapphire. If looked straight down upon the crystal, that is its 'C' axis, the gem will appear to be blue, but if looked at 90 Degrees or side on the crystal will appear green.

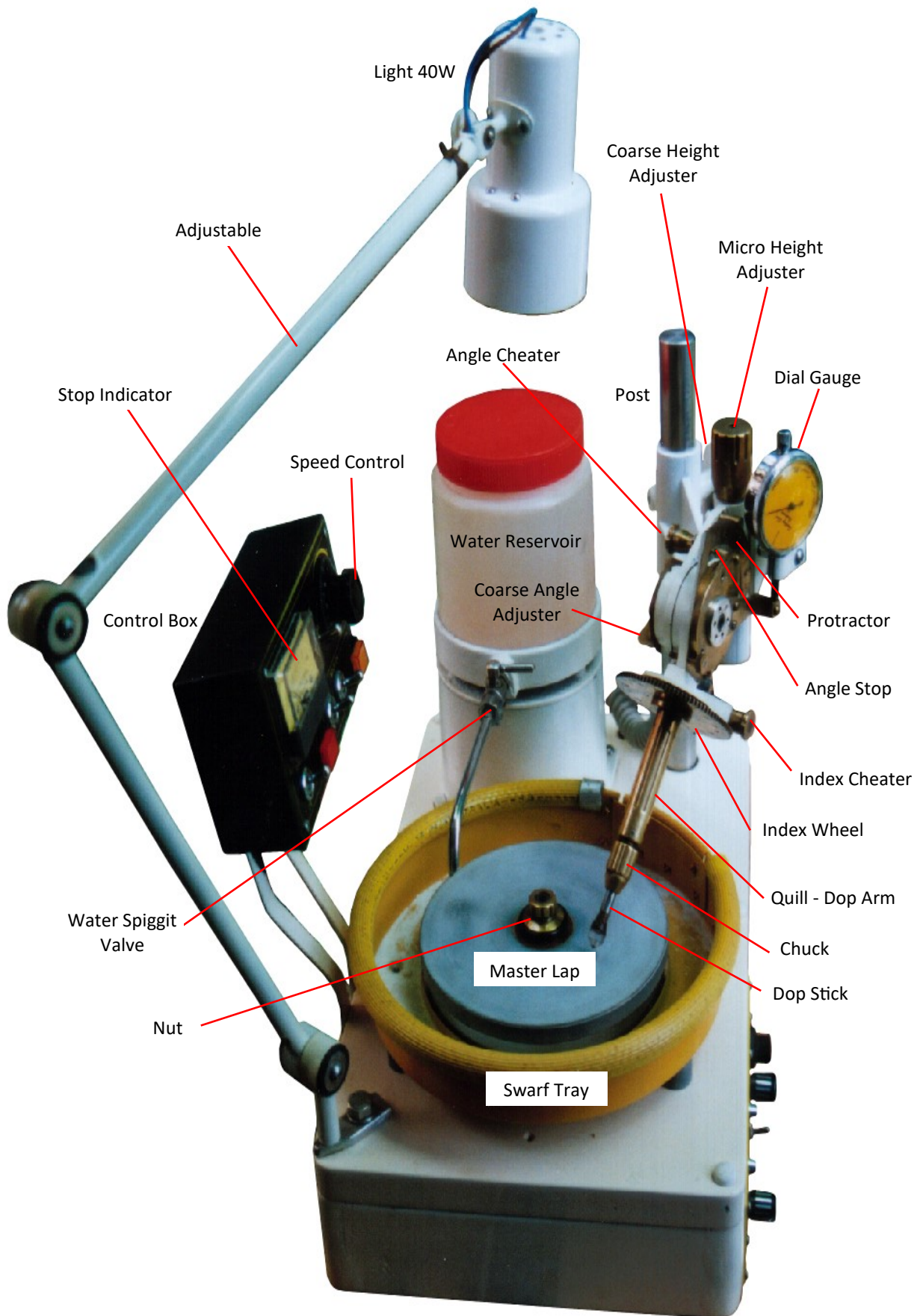
The gem Iolite also shows this phenomenon, but has three colour changes. Blue, clear, and yellowish.

An instrument used for viewing this effect (dichroism), is called a Dichroscope, and is made from a piece of clear calcite and a lens situated in a small tube.

SAPPHIRE CRYSTAL SHOWING PLEOCHROISM

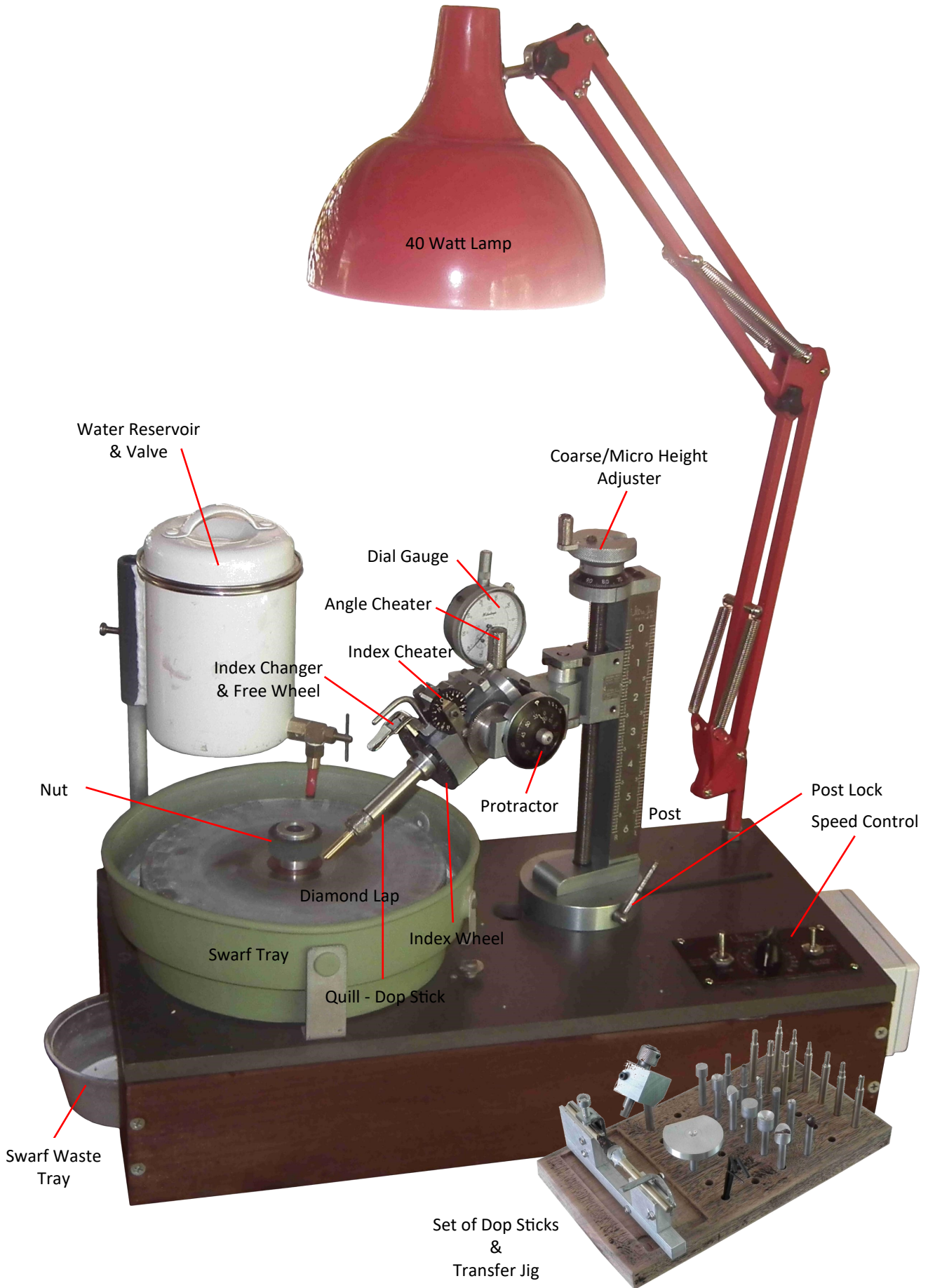


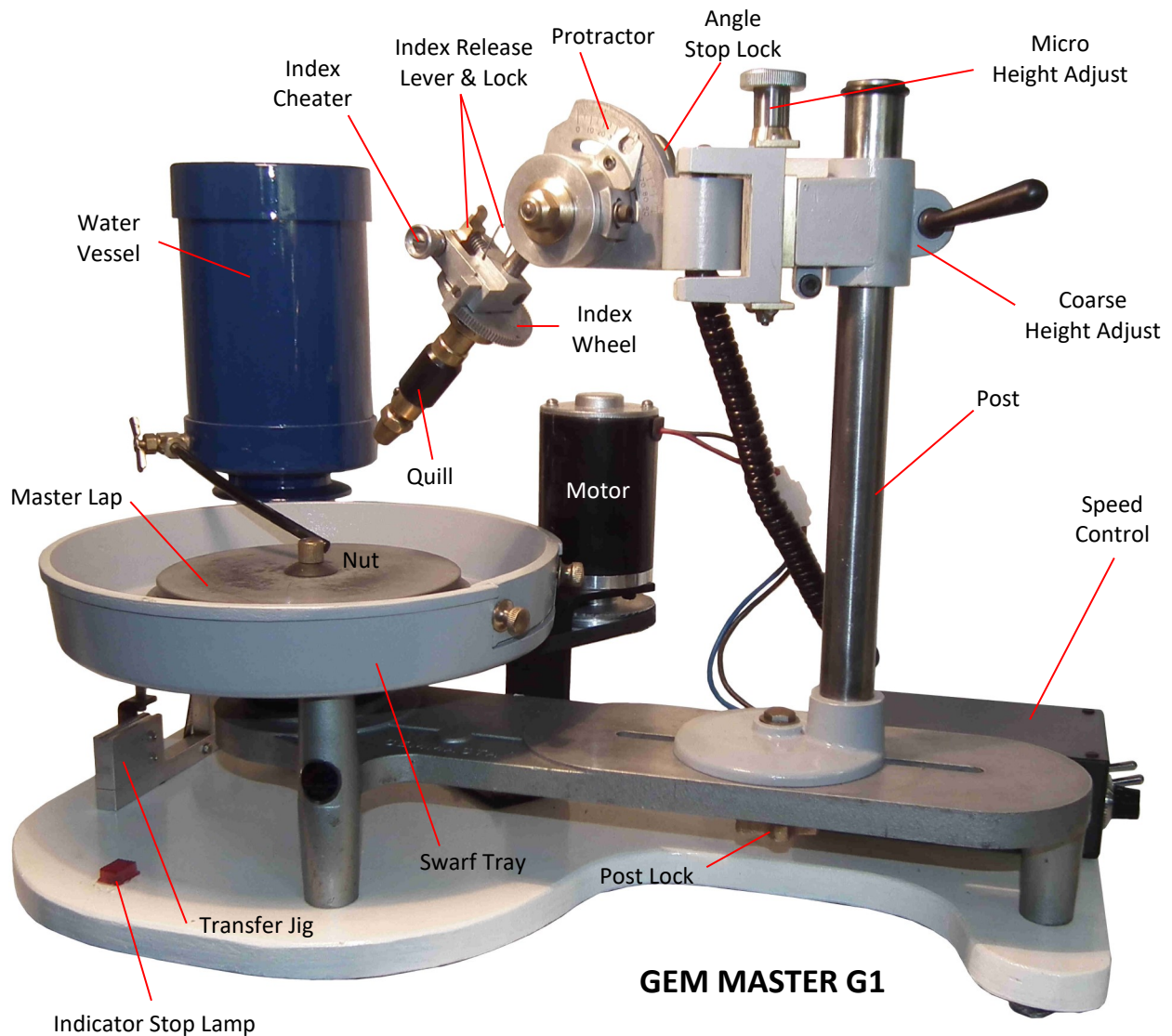
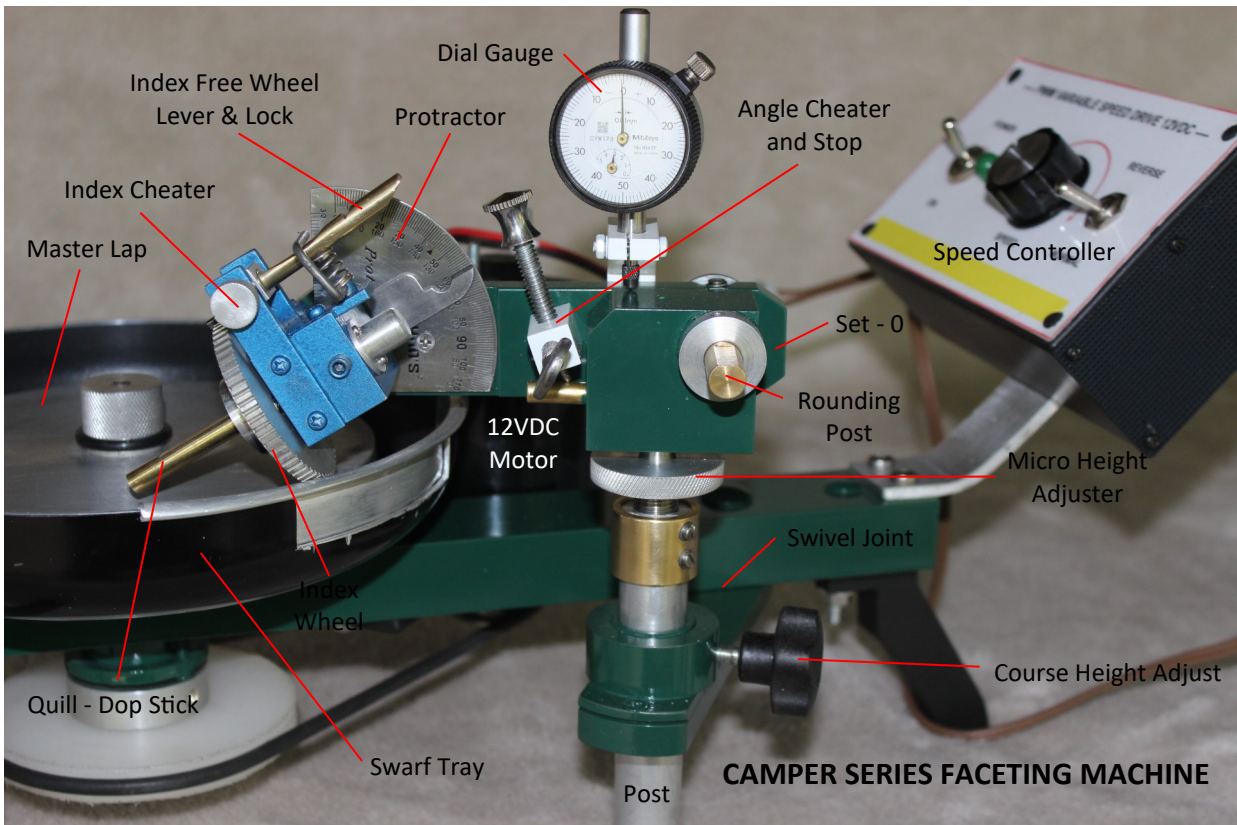
CHAPTER 2 - HALLS MKII FACETING MACHINE



Remember, with any machine, no matter how good it is, will not be as good as your eyes. The old saying "CUT A LITTLE LOOK A LOT" always apply.

ULTRA TECH FACETING MACHINE



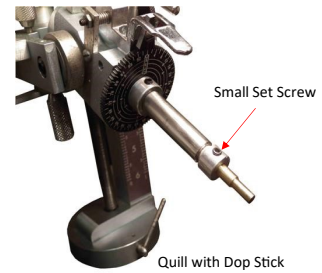


TERMINOLOGY

- **Quill & Alignment Tool**

The quill or dop arm as it is sometimes called, houses the mounted dop stick, and is attached to the toothed gear known as the index wheel. This quill has either a self centre chuck or a small set screw to lock the dop stick in position.

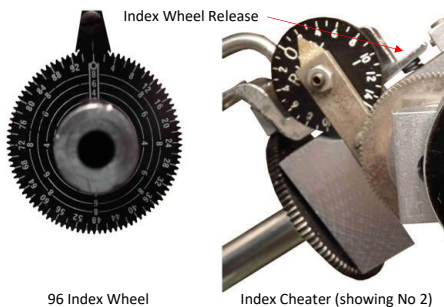
Some machines do not have alignment notches built into the quill or transfer Jig, and alignment tools makes life easier for aligning facets between the Crown and Pavilion. A good machine should have at least one of these. The alignment tool allows for perfect realignment, should you have to remove or replace the dop stick at any stage whilst cutting or polishing.



Small Set Screw
Quill with Dop Stick

- **Index Wheel & Cheater**

The index wheel is the large toothed gear and comes in a variety of indexes. Normally the machine will come with a 96, and/or a 48 index wheel as standard equipment. These indexes should be easily interchanged without difficulty. If not - be wary!



96 Index Wheel

Index Cheater (showing No 2)

The index wheel can be released by pushing in the arm of the spring retainer so the quill can be moved in either direction (as with most machines). This arm can be locked into position so the index wheel, and quill can turn in a 360° for rounding.

A small amount of movement, either left or right of the main setting is available by using the index cheater. The cheater will allow for small errors in cutting or polishing, and normally will have a centre mark to help you show direction (left or right) when cheating.

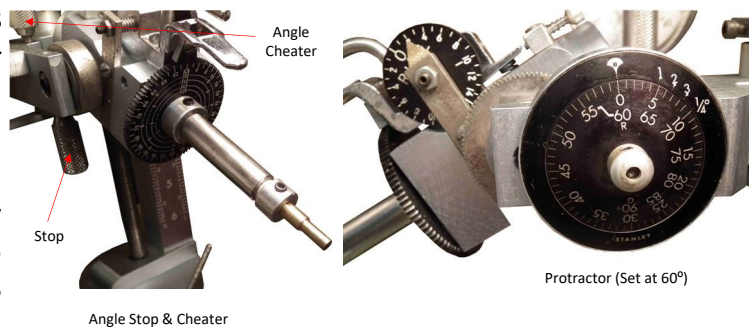
- **Protractor, Stop & Cheater**

The protractor is probably the most important part of the machine, and should have clear engraved half degree divisions with a good marker, pointer or face that can be seen, and read from nearly all directions when in normal operation.

The angle stop sets the quill to any angle between 0 and 90° on the protractor, and should move freely between the stop, and the set angle.

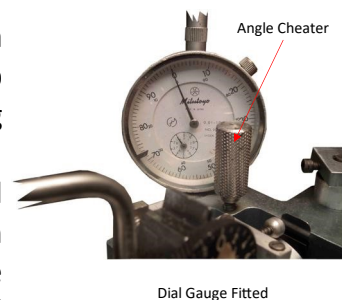
Most machines will incorporate a dial gauge and/or a small indicator light to give the operator a warning when the stop is reached. The stop should be solid, and held firm by a locking device so the quill cannot past this point.

Located on the stop, may be an angle cheater, a small tapered shaft that can be screwed in or out to adjust the angle by the 10th degree, but be prepared, there are a lot of machines out there that do not have an angle cheater, in fact most faceters will tell you that the angle cheater is not necessary.



Angle Stop & Cheater

Protractor (Set at 60°)



Dial Gauge Fitted

- The Post & Coarse Adjuster

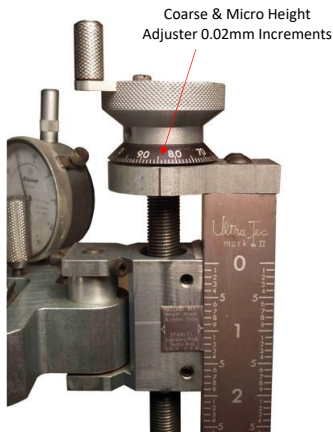
The post is the main support for the head assembly and is 90° to the base plate. The post can be either fixed or adjustable along a slide that is fixed by a locking nut. On this post, to which the head assembly is fitted, is a coarse adjuster. This is a large knurled knob which releases or tightens the head assembly to the post so the quill can be raised or lowered by hand (coarse adjustment).



Base Assembly Lock
Pull Handle Down to secure Post to Base

- The micro Height Adjuster

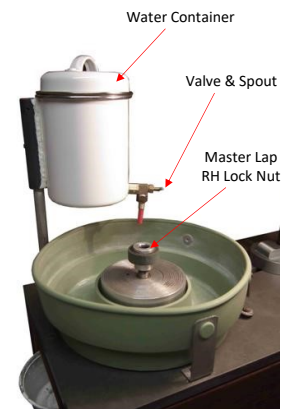
Fitted to the head assembly or in some cases to the main post support. The micro height adjuster should be adjustable within a span of approximately 25mm, and is normally marked in graduated steps of 1 to 5 thou increments. Some machines do have micrometers fitted as part of their standard equipment.



Main Post

- Water Reservoir

A good reserve of water should be available to the faceter. Normally all faceting machines will have a reservoir fitted to the side of the swarf tray, and have a capacity of 500 mils minimum. A stop valve should be fitted to allow control over the water flow, and the container should be able to be swung away from the lap when required.



Ultratech Swarf Tray

- Speed Control & Motor

All faceting machines must be driven by an electric motor of sorts (or can be hand crank). This can be by either 240V or 12/24 Volt, and is normally belt driven by stepped pulleys or variable speed control.



Ultratech Speed Control

If a fixed 2 or 4 pole motor is used, then the faceting machine should be fitted with a stepped pulley system so the speed can be changed manually. A good speed for minimum is 100 rpm to around 1400 + for fast speed.

The best system is a variable speed system either in 240V, 12 or 24 Volt. 12/24 Volt is preferable due to high torque and less noise.

As mentioned earlier, all machines today can be considered a marvel of modern engineering. Some are better than others, and some offer more incentive by gimmicks, and attachments, but all in all, the faceter has to make the decision that suits him best. The main criteria for any faceter is **Ease of Operation** when facing the machine in the standard cutting mode.

CHAPTER 3

FACETING EQUIPMENT

- **FACETING MACHINE**

Should include dop sticks, transfer jig, 45 degree angle dop and a flat dop. It seems that quite a few faceting machine manufacturers don't include flat dops in their kits. If you happen to be one of the unlucky ones, don't despair, as a valve from an auto or bike shop will suffice quite well. Just be sure that it has a 1/4" or 6 mm shank. Essential tools, such as small spanners, screwdrivers and Allen keys are a must.

- **LAPS**

A lap is a flat disc which is used to cut and polish gemstones. Today there is a multitude of laps offered for sale, but none better than the good old copper lap. The copper lap has been around for many decades, makes an excellent pre-polish lap and is still preferred by many experienced faceters. These type of laps have to be charged with diamond powder, are cheap and easy to maintain.

Metal bonded laps have diamond powder electroplated onto a thin copper disc which is glued to a master lap made of aluminium. These type of laps are more expensive than the copper laps, but cut flat and true with good clean facet edges. I have found from experience, that the pre-polish lap do have a tendency to become dull very quickly and therefore is not recommended for the beginner until he or she has gained more experience. Coarse laps on the other hand are a must for the faceter and will last an extremely long time and are well worth the few extra dollars to buy.

Polishing laps also come in a variety of types, namely: Aluminium, brass, ceramic, Lucite, cast iron, iron, tin lead, type metal, and even timber, but one can't surpass the ever popular tin lead lap for polishing as an all round general purpose type. Used with 50,000 mesh diamond powder, it will outperform all other laps due to the metal's ability to polish most gemstones.

LAPS REQUIRED

- (1) Coarse 100 to 180 grit disc grit metal bonded type - Used for quick removal
- (2) Coarse 220 to 300 grit metal bonded type
- (3) Pre-polish 1200 and/or 3000 Copper Lap
- (4) Polish Tin Lead lap - made from 60/40 solder or Type Metal

Once you have established yourself as a faceter, try experimenting with other laps. They all work very well and you will find the aluminium lap extremely good for polishing sapphires. The ceramic lap gives clean flat sharp facet edges, and is best suited to gemstones of 8+ in hardness. Not to be considered as a general purpose lap, but if you are considering entering faceting competitions, the laps superiority over soft laps must be well considered.

Cast iron and iron laps can be considered a second best to the tin lead lap. They give a good crisp straight edge and are suitable for stones of 8+ (Topaz & Sapphire) that can only be used with diamond powder and a good grade of olive oil. The laps coarseness or porosity of the metal makes it a good holder of polish powder. From experience, this lap can be considered to be on par with the ceramic lap, giving precise clean flat facets and is worth persevering with until the lap is worn in.

The last one to mention is the Lucite lap. Made of plastic and is normally used with cerium or tin oxide powders mixed with water. This type of lap is generally used for polishing Quartz, and requires the lap to be kept extremely wet while in use to prevent heat build up and rounding of the facet edges. Quartz being one of the hardest minerals I have found to polish can be assisted by the use of a small amount of vinegar added to the polish mixture. Using Lucite laps require a very slow speed.

- **DIAMOND POWDER**

Diamond grit used for cutting and polishing of gems come in a variety of sizes, ranging from 0.1 to 100 micron. The diamond powder that we use today is mostly made by man, and is more consistent in particle size than natural stones which have been sieved by a screen. Grit sizes of 80 to 325 normally come in a powder form from 1 carat to 5 carat vials. Whilst 600 mesh size and over can come in a variety of containers, vials, syringes and spray packs.

To start, we will need 1 carat of each size, 1,200 mesh, 3,000 mesh and 50,000 mesh. The 1,200 and 3,000 mesh are both the pre-polish grade. 1,200 mesh is the all rounder for pre-polishing, whilst the 3,000 mesh is recommended for doing sapphires as they suffer badly from 'Orange Peel' or over cutting due to planes of softness within the mineral. The 50,000 mesh is used for the polishing stages and is a good all round polish powder. You can however use 100,000 mesh for polishing, but polishing of the facets will take a little longer. It has been my experience that there is virtually no difference between these polishing powders when it comes to viewing the finished product.



- **ADHESIVES**

5 minute/24 hour epoxies and super glues (cyanoacrylate) are an added advantage when it comes to faceting and all faceters should have in their arsenal, Loctite 416 Super glue, Epoxy adhesive such as 'Tite On'/JB Weld and a small tube of 5 minute araldite.

- **DOP HELP**

A small container of dop help which you can buy direct from any good lapidaries supplier or you can make your own.

Made from shellac flakes and methylated spirits. The shellac flakes can be bought from paint suppliers or any good hardware store. Using a small glass container that has a tight fitting lid, such as a Promite container - half fill with shellac flakes and pour methylated spirits onto the top until the container is full. Shake this container vigorously for a few minutes once every day for 3 days and then let settle for a couple of days. Pour of the top part of the liquid into a small vial etc. This makes an excellent dopping media for faceters wax, inexpensive and will last you for years.

- **DOP STICK HOLDER**

A must for beginners or any enthusiasts, 3 or 4 dop stick holders. Made from a 1" broom handle. Don't use the wife's broom for this venture or you may very well end up in the dogs house. Cut 3 or more pieces from your broom handle approximately 30mm long and drill a 1/4" hole in the centre to a depth of around 15mm. These essential pieces of equipment will be required to hold your dop sticks in an upright position for gluing, fixing and handling your gem stones especially when using hot wax.

- **FACETING WAX**

Faceters dopping wax is made from a mixture of Shellac flakes and red Ceiling wax. Dopping with wax has been around since 'God was a little boy', and is still regarded as the all purpose adhesives for gem faceting. Normally faceting wax comes in a bundle five to six sticks per pack and is relatively cheap to purchase. Occasionally green wax can also be used but is a lot softer and can cause shifting of the stone whilst polishing due to heat build up.

- **HEAD LOUPE**

A small head loupe of 3 1/4 power and/or a 5 to 10 power eye piece, preferably one that is corrected, so there is no distortion of the outer rim when viewing an object. A good lens that can be purchased cheaply, is an eye piece from a pair of binoculars (7X50 or 10X50). You can pick these up at second hand markets etc, and they work extremely well.

- **KNIFE**

Any small knife will be fine to use. This will have to be dedicated to the job, as the blade will be used for heating, scraping, mixing and applying adhesives.

- **OLIVE OIL & Polish Extender**

Cooking grade olive oil will do fine. This oil is used as a coating to hold and distribute the diamond powder onto your pre-polish and polish laps.

When mixed with Shellite (1 part of olive oil to 40 parts Shellite), you create an excellent cutting oil extender for both the pre-polish and polish laps. Also, makes a very good cleaner for the laps. Pour the extender into a small spray bottle (50 Mil), as it will give a better coverage.

Beware of Naked Flames & Use Common Sense

- OVEN

A medium size jam tin that is cut out to suit your spirit lamp to be used as a hot plate. Used for slowly heating your gem rough to accept dopping wax to transfer onto the dop sticks



- REFRACTOL

Available from any good lapidaries suppliers, and is a must to the amateur faceter for seeing imperfections within a piece of rough. This oil has a refractive index close to mid range of most minerals, approximately 1.57. When this oil is applied (with a small fine artist brush) to the gem rough, it makes the surface extremely clear. Just like a piece of glass, making it easier to view inclusions. You can also purchase from a chemist some Clove and Cinnamon oil, as these have refractive indexes 1.54 and 1.62 respectively and will help you view gem rough that have lower and higher than 1.57.

- SPIRIT LAMP

Almost any type of burner or even a candle will work as a flame heater for heating wax and transferring, but you will find the alcohol lamp (as viewed above in a home made oven) will be your best bet, namely because of its a clean flame and heating ability compared to some other types.

- VERNIERS & SCALES

A good pair of metric plastic vernier/callipers with dial gauge to measure gem stones, a must if you consider going into competitions. Callipers can be expensive or cheap - its best to get a good pair if possible, though I must admit in the end the pocket will decide the quality.



Not essential, but advantageous is a set of scales for weighing your finished gem stones. The scales will need to be able to weigh as low as .001 carat (there is 5 carats to 1 gram).

- MISCELLANEOUS

1. Soft tissues: The best to use here is soft Sorbent toilet rolls, and it is a good idea to fix a toilet roll holder close at hand when faceting.
2. Methylated Spirits and or Acetone make a good a cleaner for dop sticks and cleaning of super glues etc.
3. Pen and Paper: Always keep at hand to write down information when faceting. Don't try to rely on memory, notes can always be referred to when required.
4. A small 4" trim saw would be a good investment, but can be done without as most stones can be cut directly from the rough. A small mandrel can be made by an engineer to take a small blade on the faceting machine. This then is used to cut the mains of the stone, thus saving the expensive laps.

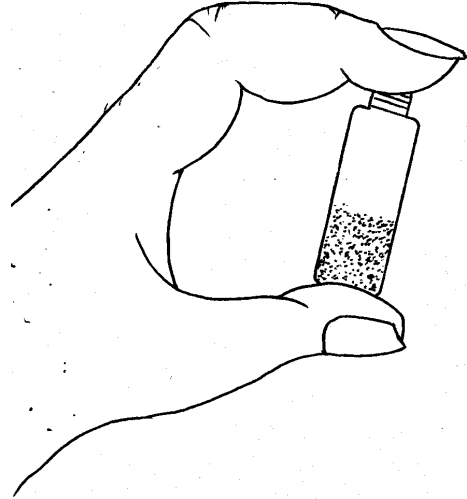


CHAPTER 4

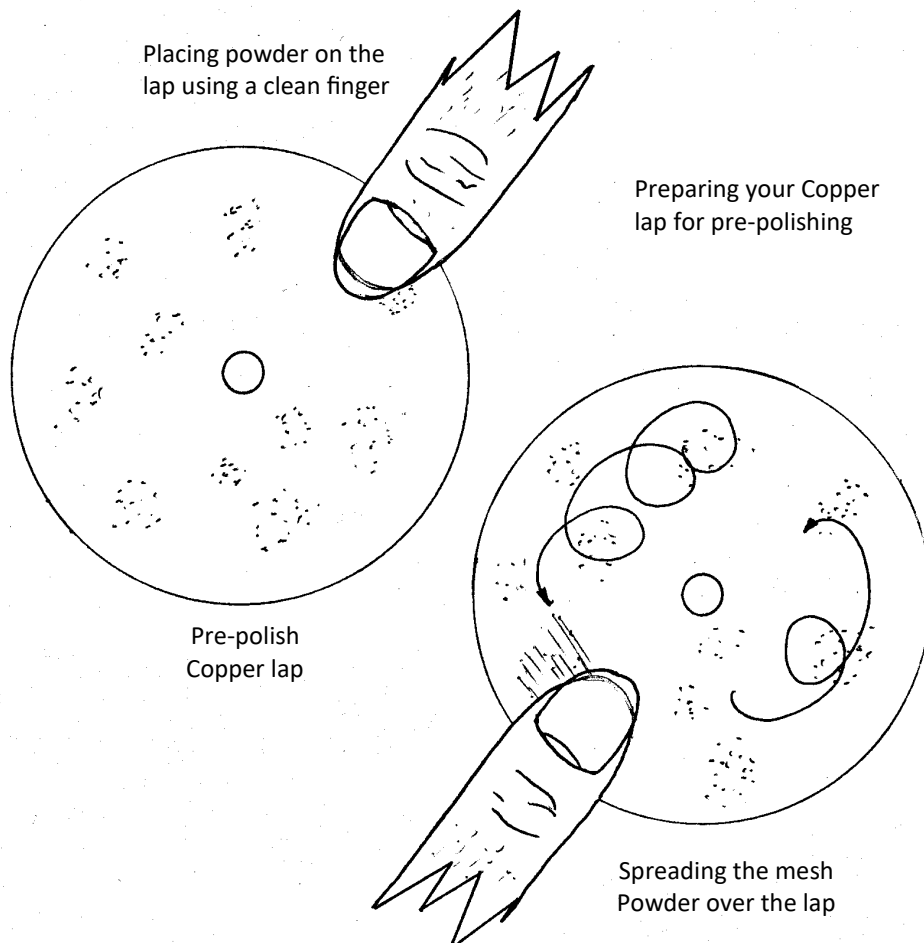
PREPARING A PRE-POLISH LAP

- **PRE-POLISH LAP**

Making up your pre-polish lap is very easy. Using a new copper lap, clean the surface with a tissue with the extender fluid. Place a couple of drops of olive oil on your lap, and with a clean tissue wipe it all over the lap until it is almost dry. You will need the vial of 1200 mesh diamond powder (pre-polish powder). Wipe a clean finger over the lap, this will leave a smear of oil on it. Open the 1200 mesh diamond powder, place the index finger over the top and invert. Invert back again and lift the finger off the vial. You will now see a grey coating of powder on your finger. Place your finger in different spots over the lap, and then spread the powder as evenly as possible over the laps surface with your finger.



The lap is now prepared, and will last a long time before the lap will need resurfacing with diamond powder.



CHAPTER 5 SELECTING THE ROUGH

As we are a beginner, let's start with a piece of topaz. Topaz has a good relative hardness, has good refractive index, is nice and cheap and will produce a gemstone of sparkling brilliance.

- CLARITY - clearness

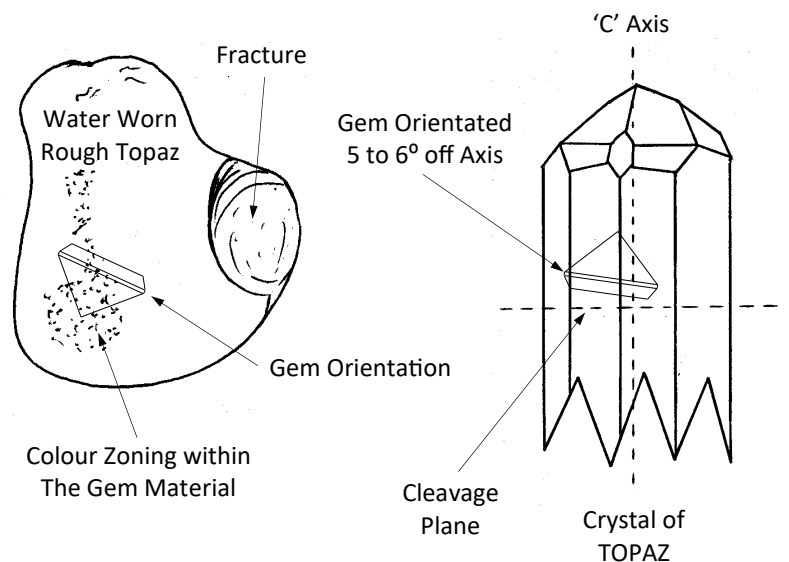
You have a piece of topaz that isn't a piece of crystal, but has been water worn and is impossible to see through. Wetting this with water will help, but not enough to be able to see the inclusions and flaws etc. This is due to the refractive index (RI) of the water (1.33) not being high enough. To be able to view inside readily we need to use a liquid close to the RI of topaz (1.63). The use of the refractol will do just that (or cinnamon oil). Paint this over the stone with an artist brush and you will be able to see right through the stone as if it were a piece of glass.

Look hard into the stone, use a five or ten power eye piece and see if there are any cracks, inclusions of other minerals, cloud veils from ghost crystals or small bubbles that are probably filled with liquid. Obviously we are looking for a near flawless stone, but as nature will have it 'Nigh Impossible'. The art of faceting is for you to be able to find the flaws and hide them if they present a problem. By orientating a gem properly, flaws or inclusions can be hidden under the girdle facets. Normally though, you wouldn't bother unless special circumstances required it, like the piece of rough being regarded as a unique piece, sentimental value or having a high price. Usually the stone would be discarded for a better piece. Also refer Chapter 3 section 3:8 on inclusions.

Now you have mapped out the interior of the rough for possible orientation and maximum recovery of that stone.

- COLOUR

Does the stone you have selected have any colour zoning in it, or is it all colour, maybe the colour is lighter on one side than the other! Stones like amethyst, citrine, sapphire and blue topaz can have one or more bands of colour. If the colour is most important (and normally is), the rough will have to be orientated in a position so



that the pavilion of the standard brilliant when cut is fully within the banding. Some care however may be needed, so that the pavilion does not protrude past this point of colour zone as the gem may lose the colour that we are looking for.

Colour banding should not be confused with Pleochroism, such as in sapphires, which are double refractive. Sapphires should be orientated along the 'C' axis for best colour, especially corn flour blue, otherwise you may very well end up with a green sapphire. Also refer Page 10 on Pleochroism.

- CLEAVAGE

Topaz has a cleavage plane which may or may not cause you a problem when polishing. If the piece you have selected is a crystal piece, or shows the cleavage plane easily, then you have no worries as orientation will be easy. If your selected stone is water worn, and there is no indication of the cleavage plane, I suggest that you just go ahead and orientate the stone as if there were no cleavage. The chance of placing a stone exactly on the cleavage line is a thousand to one, and far too much emphasis has been placed on this subject. Even if you have placed the cleavage on one of the facets to be polished there will be no real problem as polishing can be done by the hand technique discussed later in the section under 'Polishing'.

So, if your piece shows the cleavage (which is 90 degrees from the 'C' axis), you would orientate this piece of rough approximately 5 to 6 degrees away from the axis.

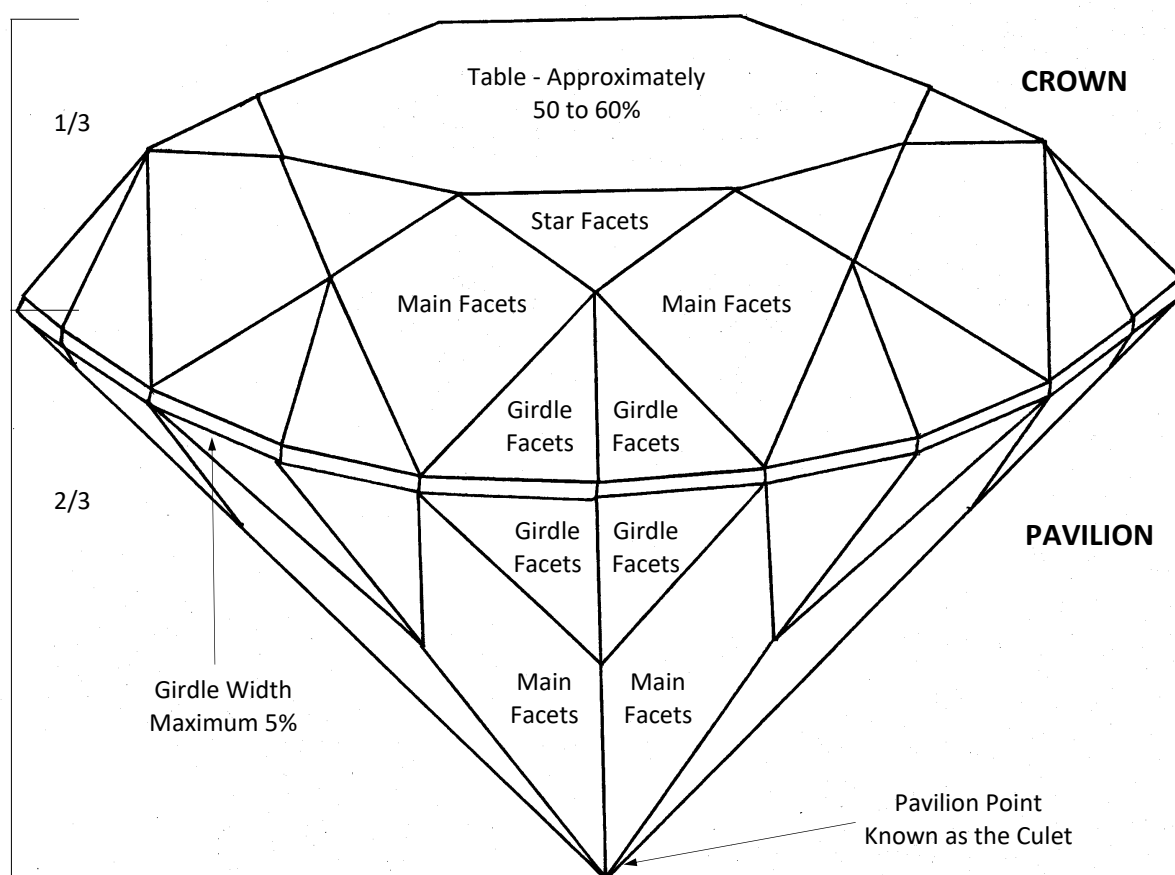
CHAPTER 6 - THE STANDARD BRILLIANT

The first faceted stones happened sometime in the late 14th and 15th century, and since that time was to be held a secret that was passed from father to son. The nineteenth century found the art of faceting and lapidary clearly available to all amateur and hobbyists. Today, numerous books are written on the subject, and many clubs are willing to teach this art.

Cutting the standard brilliant starts with a piece of rough which is rounded. Then a combination of facets are placed in geometrical patterns around the stone to make use of the optical properties of that stone, thus producing a brilliance which is pleasing to the beholder.

TERMINOLOGY

There are 57 facets in the standard brilliant - The **crown** consists of 33 facets, 8 main facets, 16 girdle facets, 8 star facets and 1 table facet, totalling approximately $\frac{1}{3}$ of the total height of the brilliant. The **pavilion** consist of 24 facets, 8 main facets, 16 girdle facets, totalling approximately $\frac{2}{3}$ of the total height of the brilliant. In some circumstances the culet can be cut as a small flat facet to prevent it from fracturing and at times is considered good practice. The maximum girdle width must not exceed 5% of the total height.



STANDARD BRILLIANT TERMINOLOGY

CHAPTER 9

DOPPING

One of the most important parts of faceting - Dopping must be done correctly. There's nothing worse, especially to a beginner to have his or her gem stone full off at a crucial point because of improper dopping.

- DOP STICK SIZE

Select the right dop stick for the stone, this would be approximately 50 to 60% of the size of the finished article. This will come to you with trial and error, and after a while you will be able to estimate with some accuracy the correct dop stick for the job.

Once you have orientated the stone correctly as per Chapter 8, you will have to grind a small flat surface on the stone to accommodate the dop stick. This is done by placing the coarse lap (220 Grit) onto the faceting machine's master lap.

Turn the tap on the water container to the on position so a reasonable flow is running onto the centre area of the lap surface. Set the machines speed to high.

Bring the stone to the surface of the spinning lap and using light pressure, proceed to cut a small flat surface for dopping.

Using a piece of toilet tissue, wet it with methylated spirits and clean the ground area (don't forget to turn off the water and the machine, leave the lap on the machine for the next phase of faceting). Paint this cleaned area with a very thin film of dop help (the one you have made). The dop help will act as a binder for the transition of wax to metal

- FIXING STONE TO DOP STICK

There are some stones that are quite heat sensitive, and it is best to use the modern day epoxies, such as 'Tite On' and/or the super epoxy called "Weld It" which fully cures in 4 hours.

Set up the heater oven, and place the stone, painted side up onto the oven's top. Place the spirit lamp underneath the oven and light.

Gauging the right amount of heat will come to you only with experience, but as a guide line, keep lifting the stone with your fingers until you find you can no longer hold it for more than a couple of seconds, this is approximately the right temperature.

Whilst the stone is warming, place your selected dop stick in one of the dop stick holders you have made.

Heat the end of the dop stick by placing the end into the flame. When reasonably hot bring the faceters wax into the flame with the dop stick, and melt some of the wax onto the surface to form a small ball of melted wax. During this time you may have to keep the dop stick moving around to retain the wax on the end. Continue to heat until the wax just catches fire (this is the right temperature for fixing).

Immediately place the waxed end of the dop stick onto the surface of the stones painted side. Lift the combination from the oven and gently , before it cools, move the stone around until it's in the right position. **BE VERY CAREFUL HERE AS THE STONE IS QUITE WARM!** - You can now see and appreciate the benefits of using dop stick holders

Put the dopped stone aside to cool down and prepare your faceting machine for the next phase of your work.

- USING EPOXIES - Dopping

Epoxies offer the faceter a simpler alternative to that of using wax. Both epoxies and superglues (401 Cyanoacrylate) are very reliable and have the advantage of being able to be worked at room temperatures. They also offer the faceter, superiority from premature failure due to heat build up causing the stone to shift while you are transferring from one dop to another and save many a burnt finger to which I can readily relate too.

Epoxies and Cyanoacrylates can be troublesome however when trying to remove the adhesive from the stone. M.E.K. thinners and or Acetone will help release most epoxies and superglues. Heat still is the best option for prying the gem stone away from the dop stick, and works very well; another method is to place into the freezer for 15 to 20 minutes and then pry apart, however this may not always work.

Using Epoxies - make sure the ground flat area on your stone has been cleaned with methylated spirits. Clean the head of your dop stick thoroughly too. You may even have to use a piece of wet and dry silicon carbide paper or similar to get it clean.

Using 'Tite On' or 'Weld It' epoxy, mix equal parts of base and hardener together. Mix extremely well. Place a small amount onto the dop stick and press onto the flat area of your stone. Set aside for at least 1/2 hour for best results.

Super glues are not really recommended for initial stone dopping, unless a stone has fallen off the dop whilst cutting where it can easily be glued back on. I have found superglues are far better used in transferring of dopped stones, and it is here that the adhesive works best.

In summary wax has the advantage over epoxy with quick drying times as does superglues, which means you could be faceting in just a few minutes after dopping. If you can wait, then I recommend you use epoxy - it's up to you!

CHAPTER 8 - ROUNDING

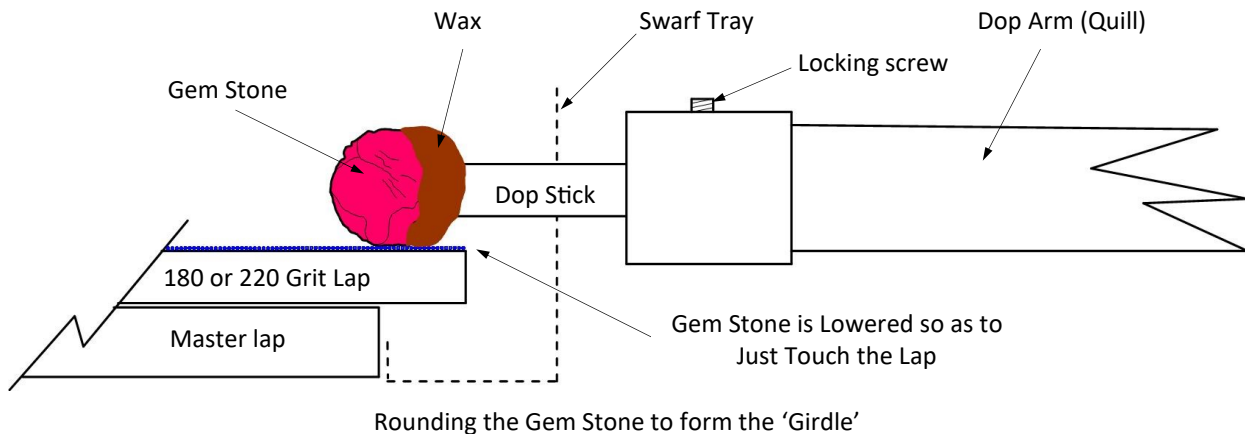
Most teachers of faceting begin with cutting the crown first, followed by the pavilion, and has been taught this way for generations. Here we do the pavilion first, with the crown and table facets being last. This technique allows for the amateur and professionals to be able to estimate more accurately the depth of material left for the crown, have better control of placing and hiding flaws under facets, easier transferring of the pavilion to crown in the transfer jig and better control of placements of facets. The down side of this technique however is that the table facet (the last one to be cut) has to be 'sat' onto the star facets and meet at every point. This can be considered good practice for when you venture into the art of 'MEET POINT FACETING'.

SETTING STONE TO QUILL - Rounding to form the 'Girdle'

Set your index wheel of your faceting machine into free wheel, and protractor to 90°. Place your coarse lap (220 Grit) onto the master lap and do the nut up firmly .

Now place the dop stick with the dopped stone on it into the chuck of the quill. Some machines, such as the Hall's machine have specially shaped dop sticks that fit directly into the quill. If your machine does not have this facility, just place the dop $\frac{2}{3}$ of the way into the chuck. Tighten up the chuck firmly.

Lift off the gate of the swarf tray, undo the coarse height adjusting wheel to free up the head assembly and carefully lower the head so that the stone on the end of the dop stick rest lightly on the edge of the coarse lap, re-tighten coarse adjuster - refer diagram below.



Now raise the stone slightly using the micro height adjuster to lift it off the lap. Start the machine at fast speed, turn on the water at a reasonable rate so that it flows outward from the centre of the lap. Slowly lower the quill with your micro height adjuster until you hear it grinding against the lap.

Rotate the gem/quill assembly slowly in an anticlockwise direction or against the rotation of the lap. Until you have gained experience in 'rounding', stick to the anticlockwise direction otherwise the gem may be grabbed by the lap and thrown off.

Keep turning until you hear a change in the grinding. This happens as you near the bottom of the stop (the stop is where the cutting reaches its maximum depth, designed so that you can't cut any further than where you had the angle set).

Lift the stone off the lap and have a look at what is happening. You will notice that some parts of the stone have been ground, and maybe some parts have not, but at this time you should be able to see some effect of the rounding.

Continue the technique of lowering and grinding until it begins to look reasonably round. Always stop and have a look at what is happening until you feel comfortable with what you are doing.

Continue with your rounding by lowering and cutting until you hear the action of the cutting stop. Check your progress until you think its right, a small pair of plastic verniers are handy for checking out of round.

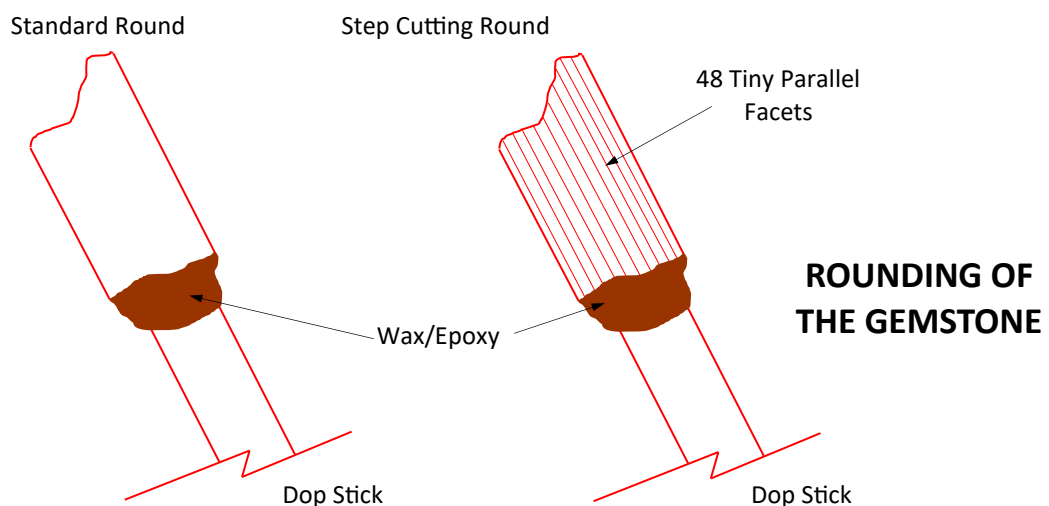
Rounding is an art, and will require a bit of practice, the old saying of 'near enough is good enough' is not on here, and you must strive to get it perfect. Any variation, no matter how small can cause errors in you facet sizes which progressively get worse. Even the best of us have difficulties in getting it right, so don't feel put off - PRACTICE MAKES PERFECT

If you are having difficulties with rounding, it will be because of using too much pressure at parts causing over cutting. To solve this problem I suggest you recut the stone in steps using 1200 Grit Pre-polish Lap (Refer Chapter 4 & Next Page - Pre-polishing). We do this by using the index gear set at 2 indexes every cut - using a 96 index wheel will produce the 48 facets needed.

Leave the assembly in the same position, place your index gear on 96 and lower the quill until cutting recommences, and cut to the stop, and then go to index 2, there should be no need to lower the quill again as you now have established the depth,. Repeat for all other indexes - 4,6,8,10,12, etc until you are back at index 96. Always try and use the same pressure, this will alleviate the problems over cutting somewhat (pushing past the stop).

When you have finished you should have 48 tiny parallel facets as shown in diagram below (this now called the 'girdle').

Don't forget to turn your water off when you have finished



You have now formed the girdle of your gem stone, it was hard but we got there. Raise your quill away from the machine, and remove the coarse lap and place it in its holder.

Now it's a good idea to check for flaws and inclusions that you could have missed when viewing the rough. Paint a little refractol on the surface and do another check. If you see some inclusions or flaws you must try and hide them under the girdle facets, or maybe they will cut out when the pavilion is done. All this has to be decided here and now as to whether you should go on or not.

Clean everything up, including your gem stone still in the quill. Cleanliness is most important during these change over of laps. Make sure you pay close attention to cleaning where your hand rests up against any part of the swarf tray. Any contamination from here on can ruin all your work let alone the laps.

Next we put on the pre-polish lap (refer Chapter 4)

We Do Not Use Water Yet on This Newly Prepared Lap

PRE-POLISH - GIRDLE

Lower the quill until it just touches the lap as before. Lift the quill from the lap and start the machine. Only use slow to moderate speed, we do not want to throw off all your diamond powder.

Now! Depending whether you are doing it the 'round' way or the faceted way for the girdle, it's best to use very light pressure until you understand what is happening. If rounding the girdle, the index wheel will be in free wheel and should be turned against the rotation, which is normally anticlockwise. In the faceted girdle you will be starting on index 96 and progressively indexing every 2 indexes until you have completed all facets.

Remember we are only trying to remove only the scratches from the last lap, and newly prepared laps cut fast. There will be no need to remove much material. When the facet/s look satiny all over the facet/s are done. If the lap seems too dry, add a couple of drops of cleaner or polish extender to it and spread with a finger. This may get a bit messy with the oil, but that's what we have the toilet tissue for. Always clean the stone every time you need to look at it. Check to make sure you have the girdle as round as you can get it. Ok that done, lift the quill aside and put away your pre-polish lap.

You may have noticed that there was no need to use water at this time, this is because the gem is being used to push diamond into the copper lap, just like when you rolled the coarse lap. Later though, this wont be the case, as the diamond is pushed in, the oil becomes fouled and forms a barrier making it more difficult to use, it's here that the lap is washed with hot soapy water until all of the swarf is gone, and from that stage on you will be using water as the lubricant. By doing the lap this way, you are getting the most benefit from the pre-polish powder, and will be able to do 3, 4 or more gem stones for a measly amount of diamond powder.

Your next step is cutting the pavilion.

CHAPTER 9 - CUTTING THE PAVILION

EIGHT MAINS COMPLEX

Set the new angle on the index head to **42°** as this is the angle designed for the pavilion mains of the gem topaz. Reset the index to **96** if you have not done so.

Place the coarse lap on the master lap (don't forget to clean everything prior). Now you are ready to cut what is known as the 'Eight Complex'. That's the first 8 facets, and it's best to cut them opposite to one another, this has the effect of reducing progressive error which must be avoided.

Using your coarse adjuster, lower the head assembly so that the gem stone just touches the lap as before, and lock into position. Turn on the machine, water at a moderate rate and lower the quill by the height adjuster.

When cutting or polishing, always use a sweeping motion across the full surface of the lap, by doing this you are preventing lap wear (forming a groove), and preventing harsh scratches and striations on the gems surface.

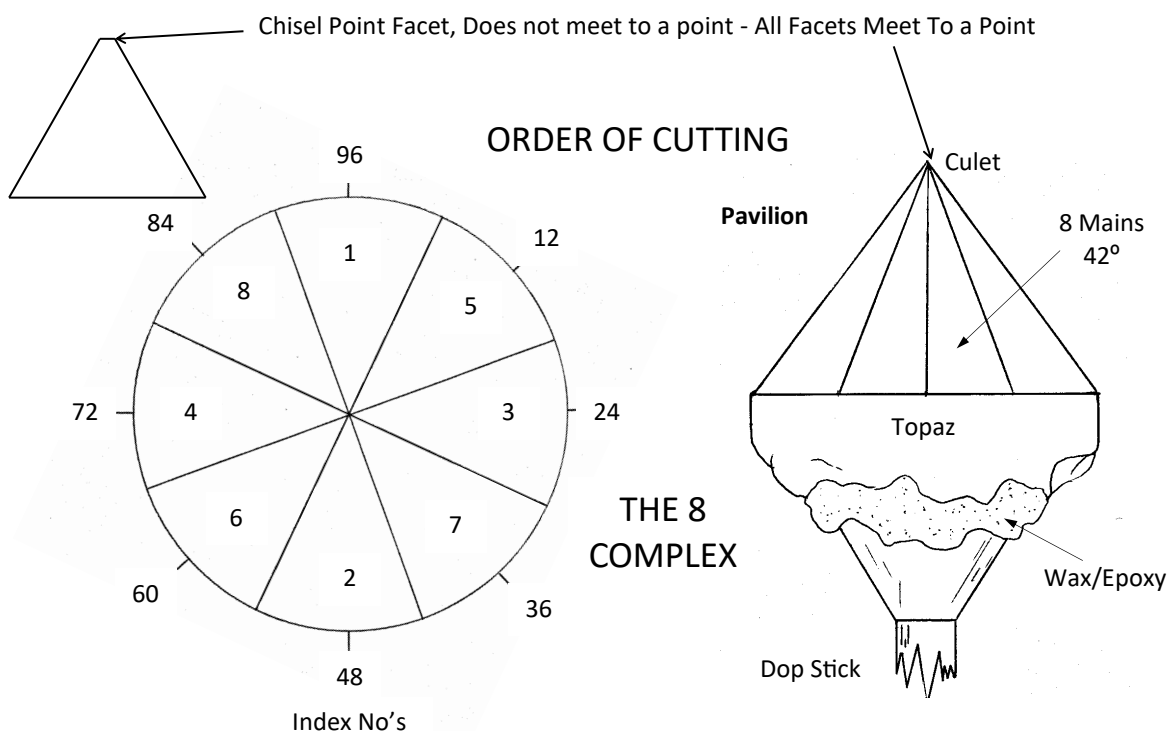
Cut the first facet to the stop and have a look. You will notice a small facet starting to cut into the gemstone. Lower the quill a little more and again cut to the stop.

Now! Lift the quill and change the index to the complete opposite no, that is 48, and again cut this facet to the stop.

see a large chisel point starting to form the pavilion. So far, so good. Go ahead and cut the other six main facets in their opposite numbers - 24, 72, 60, 36 and 84.

Familiarise yourself to what is happening and you should be seeing the mains forming to a perfect point. Continue with same sequence - lower a little, cut and look until the mains come to a perfect point (check that you do not have any chisel points at the pavilion point as these will cause errors when doing the girdle facets). This point of the pavilion is now commonly called the culet.

You have just completed the roughing in of the first major facets of the gem stone - Well Done! Now it's time to change over to the pre-polish lap. Again lift the quill away from the lap. Put away the coarse lap and clean the machine as before. Make sure that you also clean the gem stone and quill with toilet tissue wetted with methylated spirits. It is very important that this is done to prevent cross contamination from coarser grits.



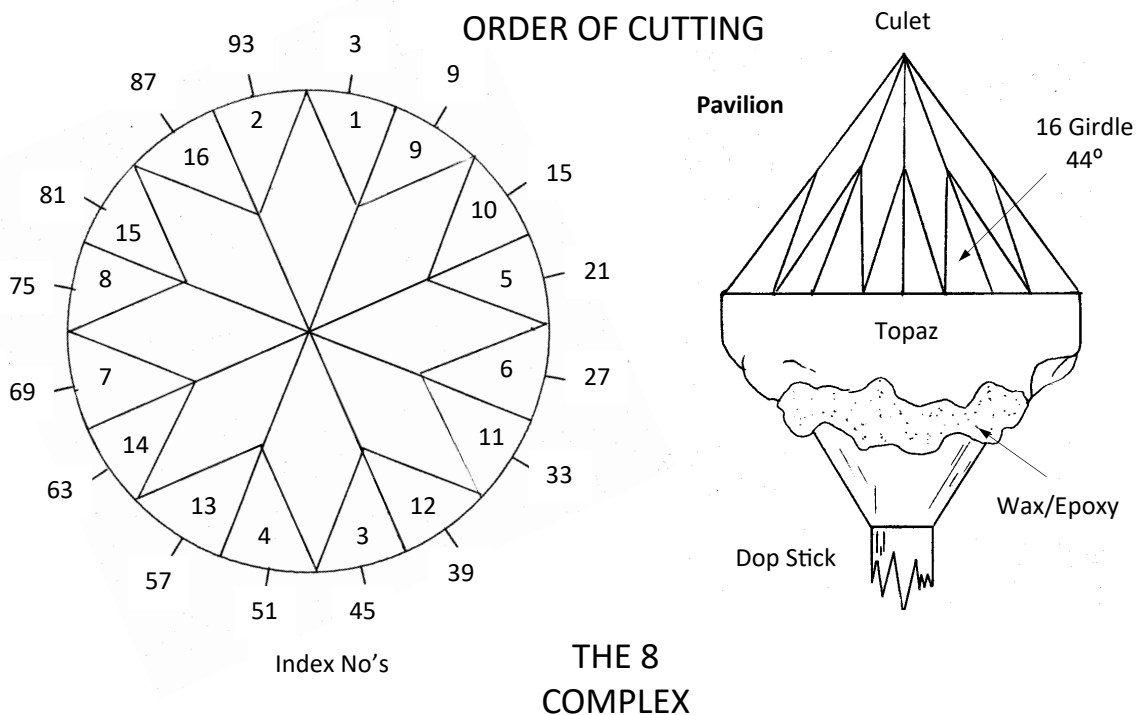
Put on the pre-polish lap as before - you should be an old hand at this now.

Again readjust the quill so it just touches the lap, and repeat all the procedures as before. You may find when doing these larger facets that a couple more drops of extender will be required. Remember that the pre-polish cuts extremely fast when new, and requires only a little pressure to achieve that satiny look. Make sure that all facets come to the exact point (no chisel points) and that no scratches can be seen under a 25 or 40 watt lamp. - You have now completed the 8 mains of the pavilion. All the other facets on the pavilion will now be done on the pre-polish lap so it can be left on the master lap.

CUTTING GIRDLE FACETS

Cutting the girdle facets are a little harder than cutting the 8 mains and require "cut a little, look a lot technique". Set the index to 3 and the angle to 44°, this is the girdle facet angle for topaz and is normally 2° more than the mains. These girdle facets extend to about half to two thirds of the way to the culet, and meet adjoining facets in the centre on the main facet, there being sixteen of them. Refer below:-

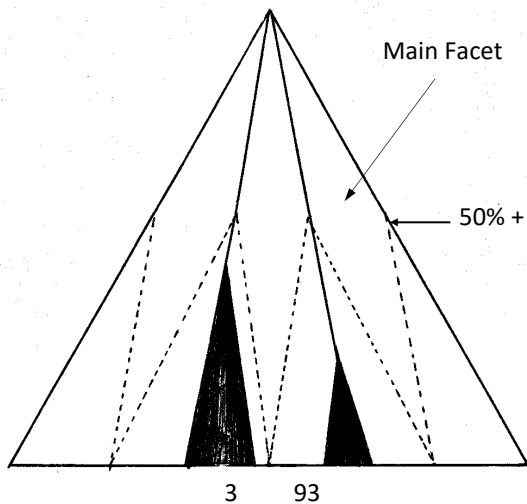
Relubricate the lap with cleaner/extender and start your machine, assuming you have already made the necessary coarse adjustments for the new angle .



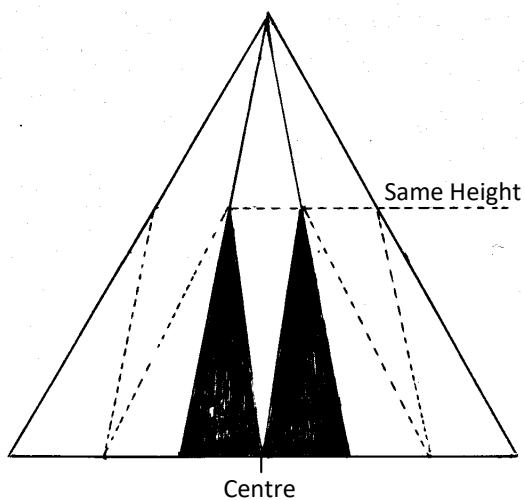
Again bring down the quill using the micro height adjuster until the gem stone just touches the lap. Cut a little and then have a look to see what is happening.

You should start to see the beginnings of a small triangle. Now repeat this step on the index number 93.

You now should have something like two triangles approaching one another as shown on the diagram next page. Lower the quill a little more and repeat the exact same procedures as above.



You will definitely notice the two triangles cutting higher up towards the culet and closer together at the base line. If everything is OK, just continue repeating the above until the facets meet dead centre of the mains as shown on the diagram lower right. You will also notice the height has automatically adjusted to about $\frac{1}{2}$ - $\frac{2}{3}$ way up to the culet. Now what you have just done is establish the **correct adjustments** for the rest of the girdle facets, so don't alter height or any other adjustments. Again you will have to work the opposite indexes as you did with the mains.



The next set to do will be indexes 45 - 51. Use the same procedures as before, and you then will have done another pair. From there you go on to do indexes 21 - 27, 69 - 75, and when these four pair have been done you can then go ahead and do the next four pair, but these will be easier as all that has to be done is to meet the points of the adjacent pairs. The indexes are 9 - 15, 33 - 39, 57 - 63, and 81 - 87.

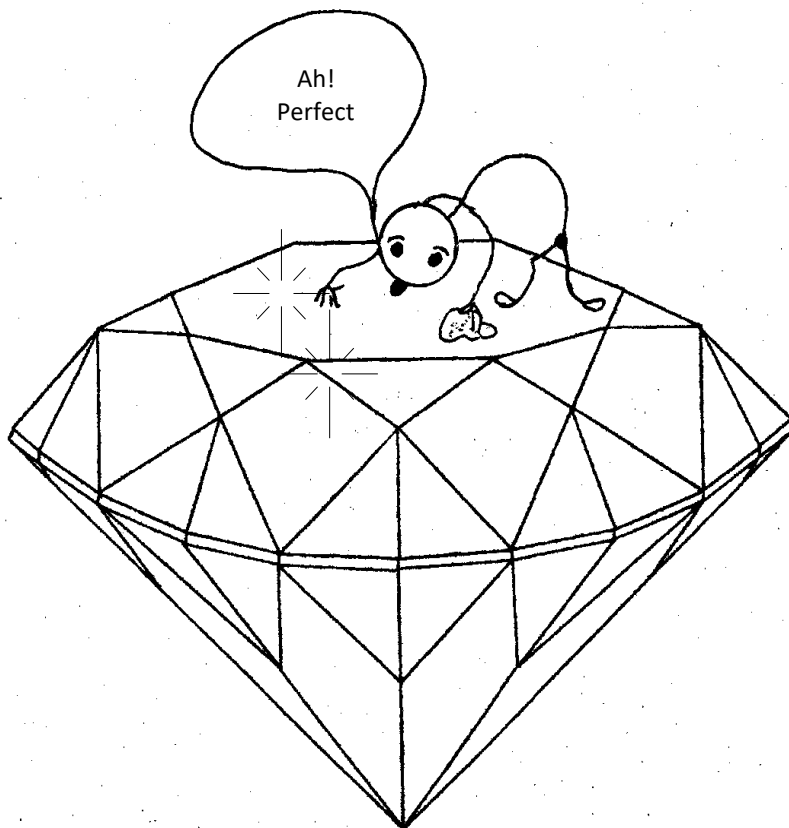
Congratulations! and well done, you have just successfully cut the whole pavilion.

Take off the pre-polish lap and put it away, clean the gem stone and quill thoroughly with a tissue dampened with metho. These bits will be covered with oil, copper oxide and some diamond powder that hasn't been rubbed in whilst cutting. While your at it clean around the swarf tray, especially paying attention to the area where your hand touches. You cannot afford to get contamination on the polish lap or you can considered it 'Bugged'. The cost of re-lathing a lap today is not all that cheap.

CHAPTER 10 - POLISHING

Polishing; an art in itself - Pro's and amateurs alike will tell you that cutting a stone is relatively easy compared to polishing, and can be considered to be the most important part of faceting, and so it is. Unless you get it right it just won't do. Gems that have microscopic scratches, grooves and lap striations (due to polishing in one spot on a turning lap) will lose a lot of brilliance. Light reflection requires a good polished surface. If light hits a good polished surface it is totally reflected, but if it strikes a poorly polished surface, light will be sent in all directions, most of which will be lost outside of the gem thus producing a gem of less brilliance that looks hazy or fuzzy, so it stands to reason that a good polish is essential for obtaining a gem with lots of brilliance and scintillation. You must always strive for perfection in polishing, because in the end it will definitely pay off.

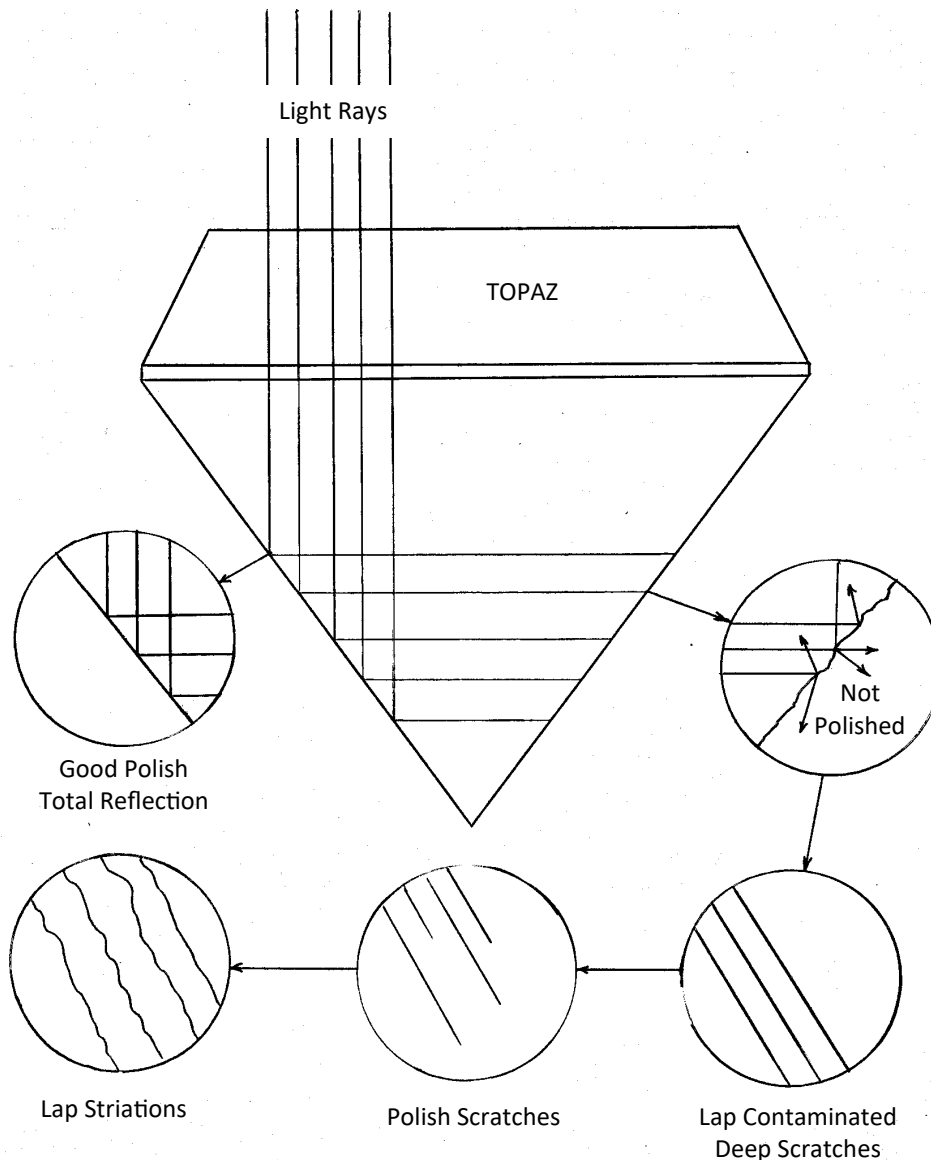
Today there is an arsenal of combinations that use different laps and agents for polishing, but none better than that of the old reliable tin lead (60/40 solder) and 50,000 diamond powder. True enough, there are times that it will not work on a gem that seems to defy all combinations, and that is where at times hand lapping can come into its own. This has saved my bacon many a time, and it is worth spending some time on it, so you too can acquire a technique of your own (discussed later).



One of the main advantages of using diamond powder compared to other combinations such as Linde A and tin lead is that diamond powder does not have a tendency to 'ball' and cause scratching on the polished surface of the gem. Therefore, the lap does not have to be scored as required by other combinations. This lap is also a dry lap as no water is used during the polishing stages and is one hell of a lot less messy, and very economical to use.

IF AT FIRST YOU DONT SUCCEED - TRY, TRY AGAIN

A saying worth its weight in gold. Don't give up, faceting is truly a wonderful hobby.



Olive oil (as used in the polish extender) is used for preparing the polish lap as diamond powder has a great affinity for oil.

Polishing is done in the reverse order of cutting, that is girdle facets first followed by the mains. The reason for this is that diamond powder is an abrasive polish, and therefore cuts a little when polishing, which causes the facets to be over cut. When you come to do the girdle facets, you will notice they ride up on each other due to this over cutting, so when doing the main facets you will notice the facet cutting back towards the true girdle line.

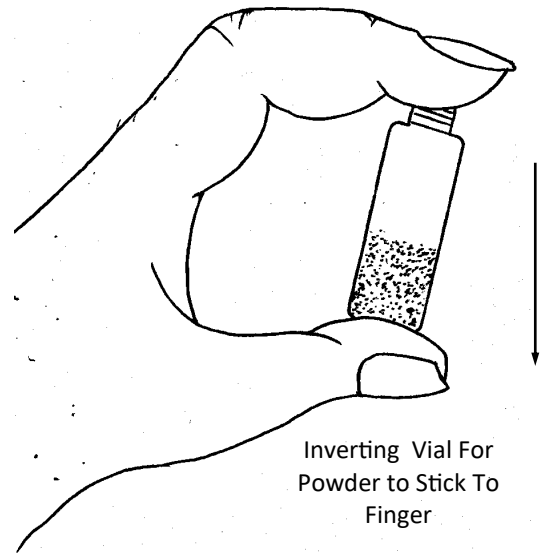
12:1 PREPARING POLISH LAP

Put on the tin/lead lap (polishing), and clean the surface with the extender thoroughly. Using a piece of toilet tissue, wipe the surface dry.

You may notice that the lap appears greasy looking, and you would be right. That thin film of olive oil left on the lap is the base to which the diamond powder will adhere.

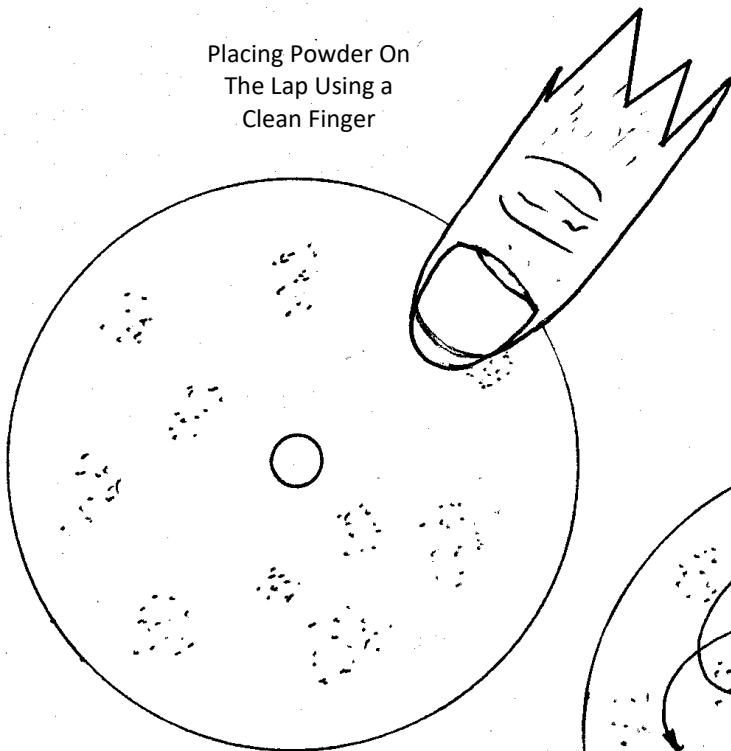
Now's the time to get out the 50,000 mesh diamond powder. Unscrew the top off the vial, wipe a clean finger across the lap (this will leave a small smear of oil on your finger),

place the finger on top of the vial and invert. Invert back again and wipe this grey powder which has adhered to your finger over the surface of the lap as thoroughly as you can. This process should theoretically polish your whole stone, but in practice doesn't, this is mainly due to the oxides from the tin and lead fouling the lap.



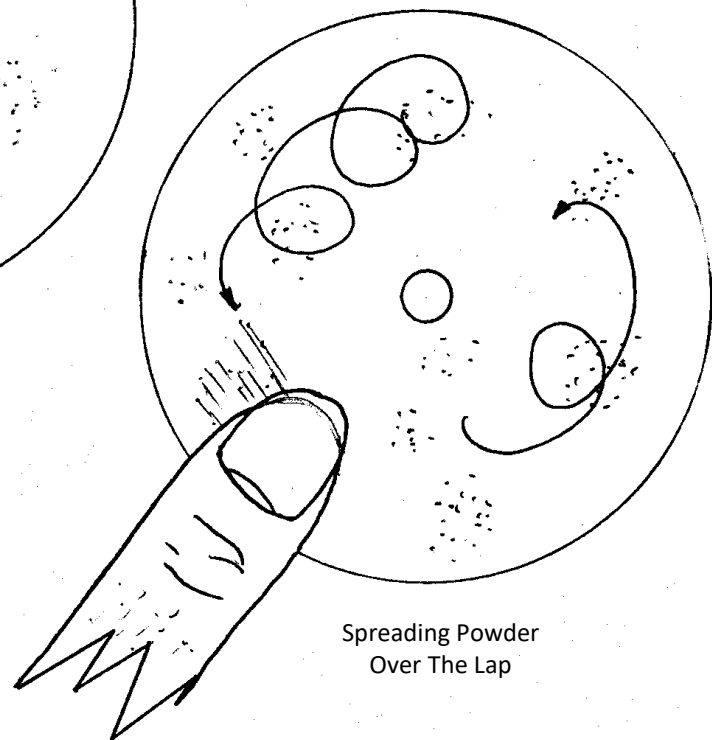
Inverting Vial For Powder to Stick To Finger

Placing Powder On The Lap Using a Clean Finger



Tin/Lead Polish Lap

Preparing Your Tin/Lead Lap for Polishing



Spreading Powder Over The Lap

POLISHING GIRDLE FACETS

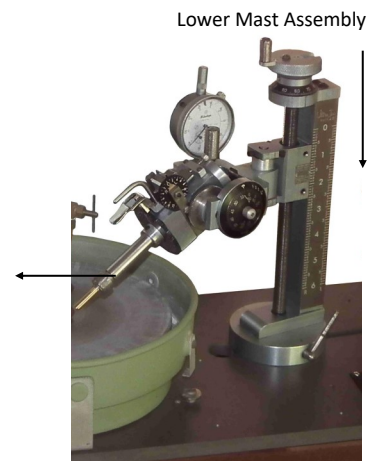
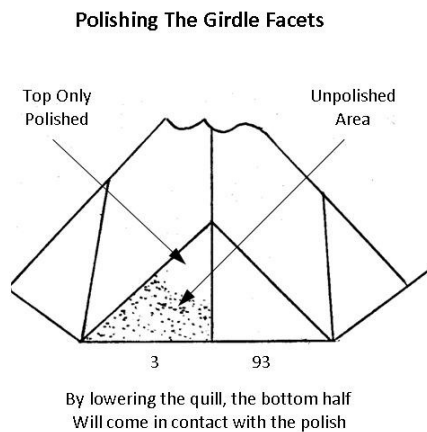
Set the index wheel to index 3 if you have not already done so, and leave the angle as it was (44°). Lower the quill with the coarse height adjuster as before so that it just touches the lap and tighten into place. Lift the quill aside and turn the faceting machine on to low speed. Using the micro height adjuster raise or lower the quill until you can just hear (or feel) the gem stone touch the lap, and then lift off again. Now disconnect the stop by setting the angle to around 25° or so. By doing this you have, relieved pressure from the angle stop so the head assembly can't be pushed, stressed or bent out of shape by pushing past the stop when raising of the quill is required. We certainly cut to the stop, but never polish on the stop. Until you are thoroughly conversed with cutting **DON'T DO IT.**

Put the gemstone against the lap gently, and work it across the surface for approx two seconds. Lift the quill up, clean the facet with a piece of tissue, and check to see how it's polishing. The girdle facets depending on the size, should only take approximately 5 seconds to polish. Hmm! It doesn't look right, only the top appears to be polishing. **WHAT TO DO.** By lowering a very small amount with the micro height adjuster, you will be altering the contact area of the polishing so that the bottom half comes into better contact. A good point to remember: *If it's high - lower height — if it's low - increase height*

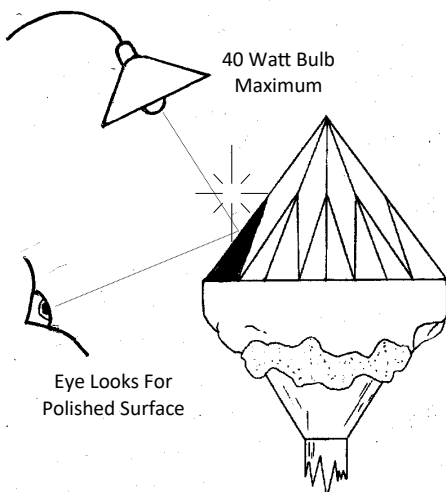
Now try again for a second. Yes, that's much better, we now have full contact of the surface. Never polish longer than several seconds at a time as this causes a heat build up in the gem, and may cause the stone to shift.

POLISHING & LIGHTING

Now! Is that facet really polished. Can you 'SEE' that facet clearly. Lets look at that light you are using. You're what? Using a 60 watt globe. No! No! No ! You



Lowering the Mast Assembly pushes the gemstone forward which puts the unpolished facet into better contact with the lap surface.



may very well be 'blinding yourself' with the illumination.

A few pointers on using lighting before you go any further:

The best lighting you can use is a single 40 Watt standard clear household globe or 12 Volt 21 Candle power. Preferably with a dimmer control fitted. I have found by experience all the fancy lights and high wattages are a big mistake. A light that is too bright, actually masks the scratches so that you cannot see them.

What you are looking for are shadows across the scratches. Not a brilliance that nearly blinds you, and gives you severe eye strain. As you become more familiar with the lighting you will understand the logic and reasoning behind using very low wattages. Try to get the reflection of the filament on the facet, and as sure as you are reading this, the scratches if there will jump out and grab you. Always try and go for perfection when polishing and you will not be sorry afterwards

Wow! The first facet is polished and completed. Congratulations, but don't get too cocky, we've got a long way to go. Go ahead and do the rest of the facets as outlined (you do not have to do opposites when polishing, as they are already cut and set). Indexes - 3, 9, 15, 21, 27, 33, 45, 51, 57, 63, 69, 75, 81, 87 and 93. Finished! Good now reset the machine to do the main facets (that's the eight large facets - 8 complex).

Using the angle 42° , set up and start polishing as you did for the girdle facets. Don't forget to disconnect the stop when set up is complete. We do not want to stress the quill.

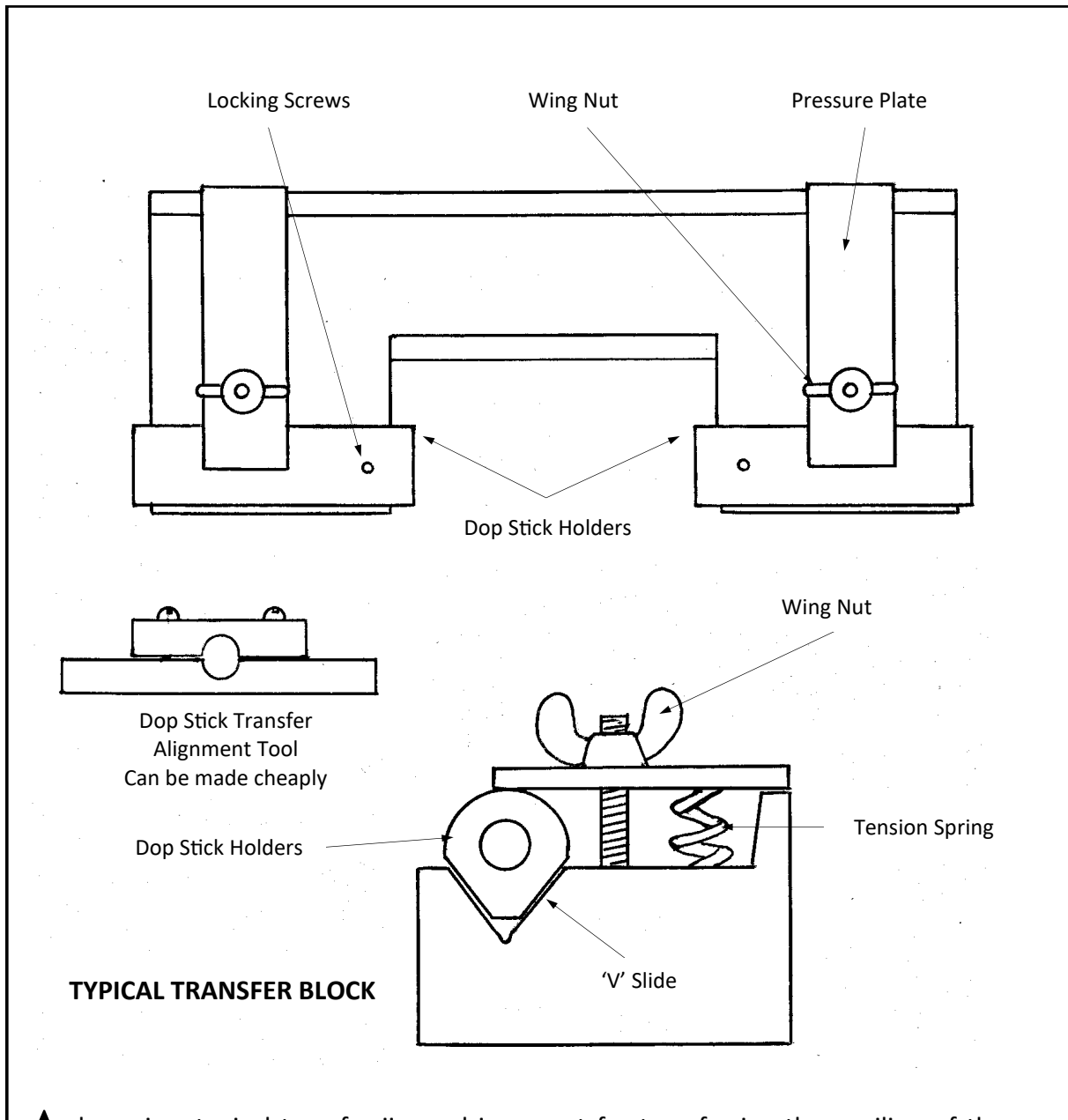
You will notice as you are polishing the mains, the point will cut down to the girdle line to meet as three points, and that the polishing of the facet will take longer as the facet is larger.

If you find the polish is losing its ability to work well. Go ahead and redo the polish lap as outline in Chapter 10

When you have completed the pavilion, clean the gemstone, and quill with toilet tissue and meths and then take out the dop stick from the quill.

NOTES:

CHAPTER 11 - TRANSFERRING



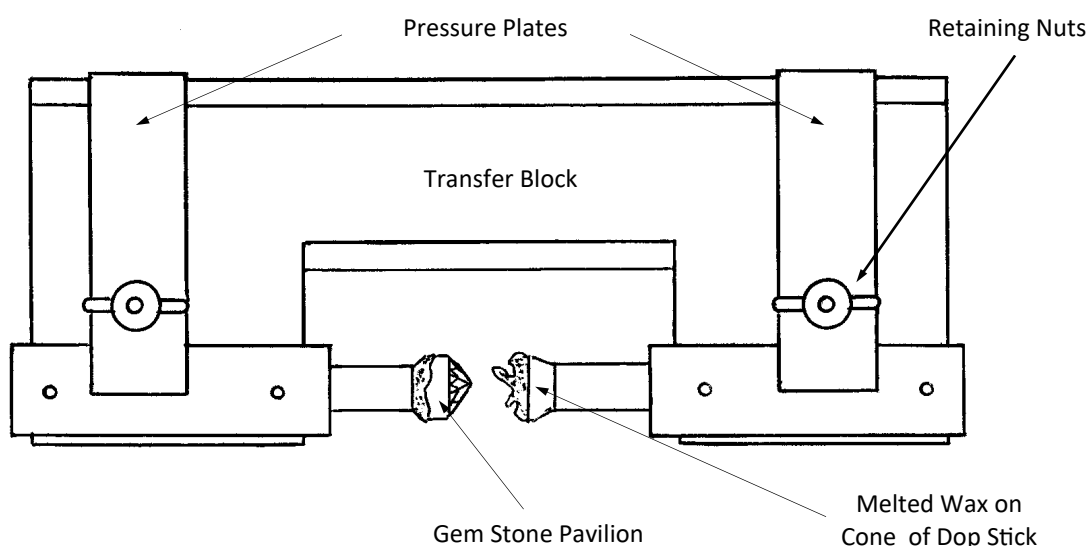
Above is a typical transfer jig, and is a must for transferring the pavilion of the gemstone to face about so that the crown can be cut. It is an extremely efficient and accurate way to transfer from one dop stick to the other without losing alignment of facets. In faceting you must have a good transfer block. These can be checked by putting in a couple of the same size dop sticks in the holders, and bringing them together. Run a finger nail across the join, and if your nail digs in at the junction at one point and not the other side, you should have an engineer check out the alignment of the transfer block - or check the dop sticks for bending.

A dop stick alignment tool and/or a transfer jig with adaptors makes life easier for aligning the main facets up.

CLEANING & PREPARING DOPS FOR TRANSFER

Clean the pavilion with a little meths and toilet tissue. Brush a little dop help on the gem, and I mean a little. If you use too much dop help, it takes a long time to dry effectively, and this will cause the gem to shift due to the longer heating time required to dry it.

Place the dop stick into one of the transfer blocks (normally the left hand side) and then select the opposite dop, which will be a cone shaped to fit the pavilion, and approximately half to three quarters diameter of the gem stone. Melt a small amount of wax into the cone of the dop stick, and when cool place it in the other side of the transfer block.



TRANSFERRING the DOP STICKS

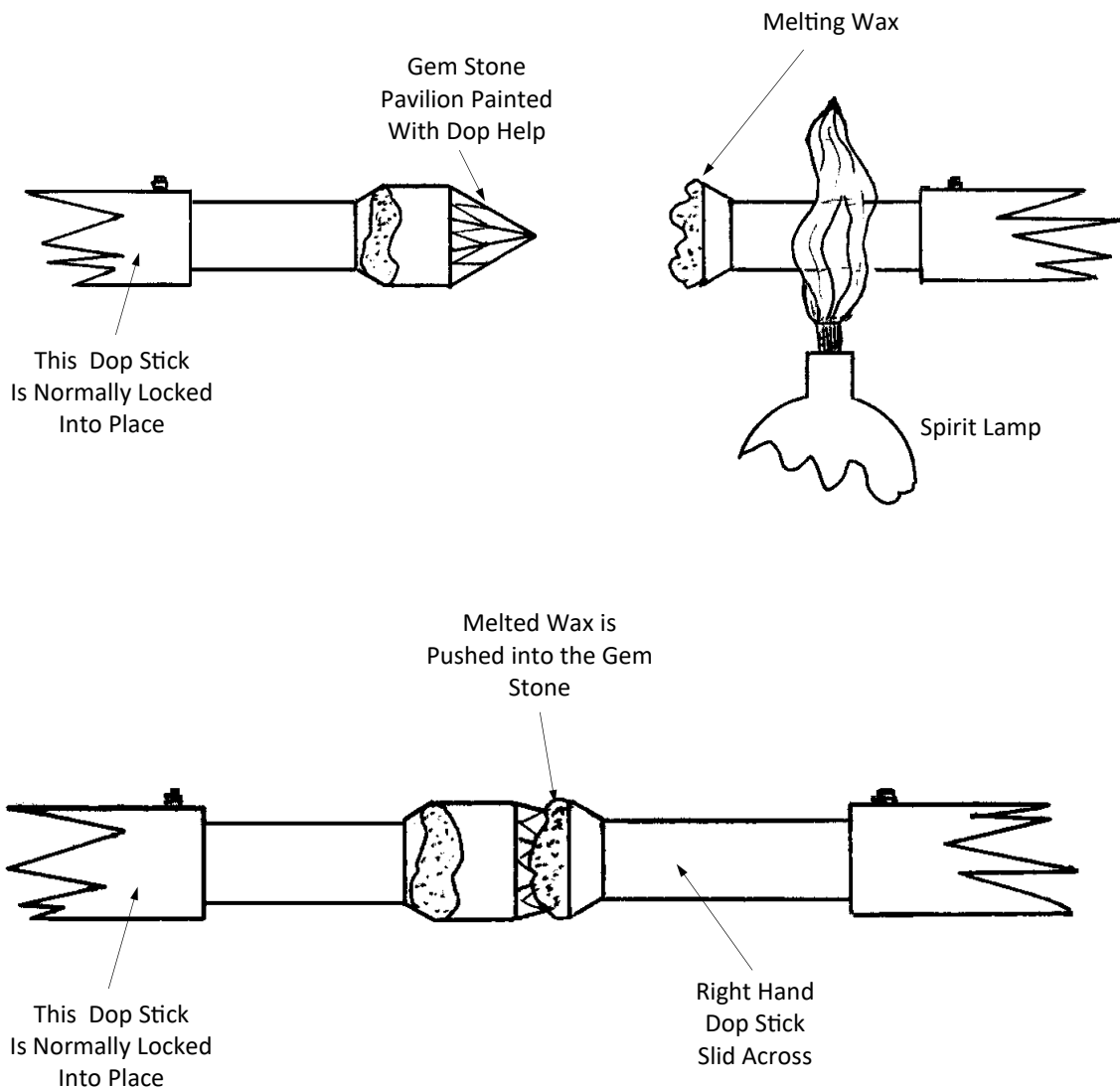
Transfer dopping - the idea is to heat the dop stick (not the one with the gem stone in it), to

The pressure plates are adjusted so that the dop sticks holders can slide in or out, but firmly.

melt the wax while slightly heating the gem stone on the other dop, yet not allowing the gem stone to get too hot to soften the wax (which will cause the gemstone to shift). When the heat is just right, you slide the heated dop stick into the other one holding the gem stone, so the wax will grab and hold.

Sounds terrible! But not all that difficult once you have had a few goes. The best way to learn, would be to practice transferring a piece of rough topaz from one dop stick to the other.. OK! The real thing now - With spirit lamp lighted and flame settled, begin heating the dop stick close to the end near the wax (remember not the one with the gem stone in it). As it begins to melt.

Slightly apply the heat to the gem stone whilst not losing the heat from the melted wax. As the wax starts to get very runny and catches fire, quickly press the heated dop up against the gem stone. Speed here is critical, otherwise the transfer wont succeed. If the wax is allowed to cool by losing its heat, it will not grab the stone (refer diagram next page).



This may sound like you need a medical degree, or have eight hands to do the job, but it is relatively easy, and will come to you with patience and practice.

Let the whole assembly cool down for ten to fifteen minutes (have a smoko break) and take out the assembly from the transfer jig by releasing and removing the pressure plates, and undoing any locking screws in the slides as above. Now test the join. The assembly must be firm, don't use too much pressure as waxes won't take it, and as sure as God was a little boy, it will come apart.

SUPER GLUE - (Cyanoacrylates) Loctite 401 a one-part instant adhesive made for porous, difficult to bond materials and has good gap filling abilities. High strength bonds wax to brass, alloy or steel with very fast fixing times of 5 to 30 seconds. Full cure 10 to 12 minutes. Loctite 406 is another favourite that can be used but has no gap filling abilities, so it is important if using 406 to get a close mated surface.

Set up the gem stone as per section 13:1, but do not apply any dop help onto the gem stone. We do not want the wax to grab and hold in this application. Apply heat slowly to the coned dop stick (not the one with the gem stone) until the wax softens and begins to melt.

Remove the heat and push the dop stick into the gem stone. Lock up the wing nuts and

let cool down. This will only take a couple of minutes.

Loosen the wing nut holding the cone dop only and pull away from the gem stone. A small force may be required here, but will normally come away easily. You will see an impressed version of the gem stone into the wax.

Apply a very small amount of superglue to the impression. Do not overdo the superglue as too much will cause a weak joint. Press the dop stick hard against the gem stone and lock the wing nut. After a few minutes it is completely cured and you can now follow the next procedures, as removal etc applies to all forms of dopping.

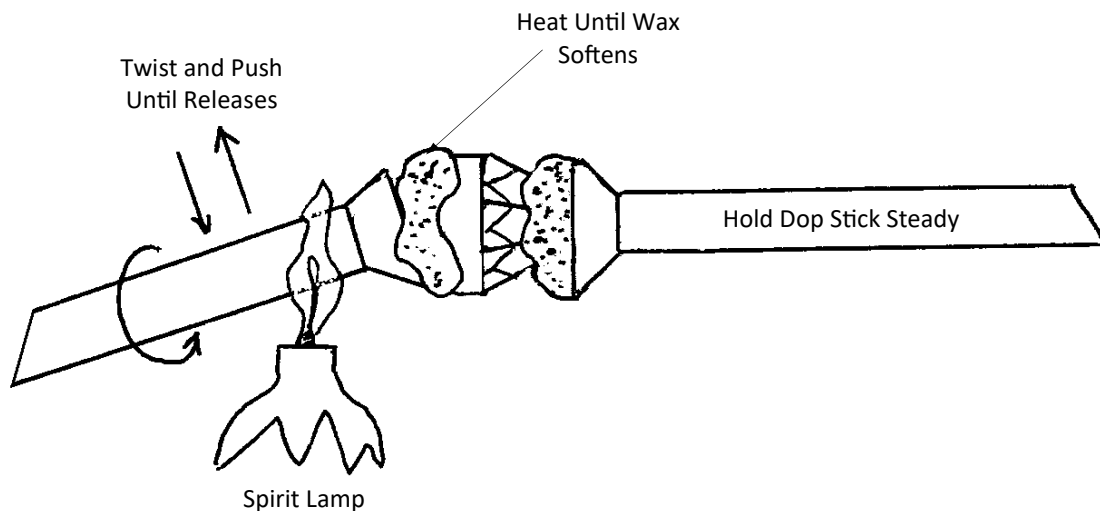
TRANSFERRING WITH EPOXY

Today epoxies make life easier, as they alleviate the problems associated with melting wax shifts. Prying dop sticks apart or away from the gem stone requires the same technique used in wax transferring. The only disadvantage of using epoxies is their setting time. As with wax and super glues, epoxies use exactly the same technique, except that heat is not used for fixing of the gem stone or the dop stick.

SEPARATING DOP STICK FROM GEM STONE

'Without alignment tool' If the machine you have has dop stick locating areas built into the transfer block and quill, there will be no need to use the alignment tool, as the alignment of the dop sticks and transfer is done automatically.

Next heat up the dop stick (Geeze! Not the one you just transferred, THE OTHER ONE), until the wax softens enough to remove. This also takes a little practice, as you are trying to heat the one side to soften the wax just enough to remove it without transferring any heat at all to the other side.



Very carefully scrape away the wax and clean the gem stone with toilet tissue moistened with meths. Put the transferred dop stick into the quill, and locate the alignment notch and tighten the quill nut or screw firmly.

NOTES PAGE:

CHAPTER 12 - CUTTING THE CROWN

Put your transferred dop into the quill and lock into place if you have not already done so. Adjust the angle of the protractor to 39° (this is the angle for the crown mains), and place the index gear onto 96.

Place the coarse lap (220 grit copper lap), onto the master lap and lock into place. Adjust the coarse height adjuster as before, to lower the quill and gem stone so that the gem stone just touches the lap, and lift off.

Again we are cutting the 8 complex, but there is a difference here, as the cutting will only progress to a certain level to form what is known as the *girdle facet*. The girdle cannot exceed 5% of the total height of the stone.

THE GIRDLE

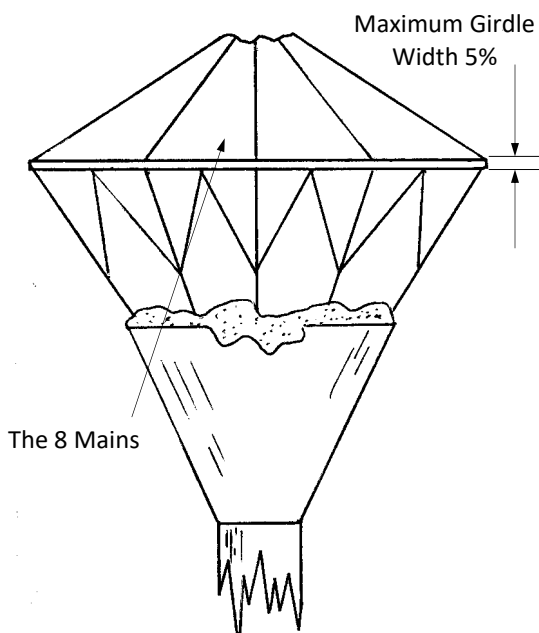
The girdle can be round or stepped cut as previously discussed in Chapter 8, under 'Rounding'. The girdle can be no more than 5% of the total height of the finished gem stone. Well now! You might be thinking, how the hell do I do this when all I've done is the rounding and the pavilion? Good question, and it so happens that there is a simple formula for working this out.

To arrive at the maximum total girdle width, multiply the diameter of the stone (this is after rounding), by .034. Let's say for example that you have a 10 mm stone after rounding. Multiply this by .034 and you have 0.34 mm. This formula gives you an approximate girdle width for a standard brilliant of $1/3$ crown x $2/3$ pavilion.

You may have noticed, the girdle wasn't polished. In competition it's a must, but I for one like the frosted girdle look, it's up to you. Polishing should be done prior to transferring.

THE MAINS

Switch on the machine, fast speed, and water at a moderate rate (just fast enough to keep the lap wet when turning). Start cutting the mains as before, Chapter 9, using a sweeping action across the lap. Keep lowering (using the micro height adjuster), and cutting until you get to approximately 5%. The reason for stopping at 5% is that you still have to cut on the pre-polish, and this will take up approx 1 to 2% of the width, leaving you around 3%.



you have cut this first facet to the set level, you no longer have to re-adjust the machine for the other seven facets.

Go ahead and proceed with the opposite index: - 48, and then 24, 72, 12, 60, 36 and 84. You may find that when you are cutting the eight main facets, that the facets may or may not reach to a point. Do not worry if the later is the case, as the star facets, and the table have yet to be done. Once the eight mains have been completed, stop the machine, clean the area thoroughly. Don't forget the stone.

Take the pre-polish lap and give it a good clean by scrubbing with detergent and water. The 1200 grit diamond powder has been pushed into the copper lap after all that cutting,

And is ready for using water only as the lubricant.

Place the pre-polish lap on the master lap, and lower the quill so that the gem stone just touches the lap, lift off and start the machine (moderate speed only). You know the drill! Repeat all the above steps for doing the mains, and pay particular attention to the facets for that satiny finish.

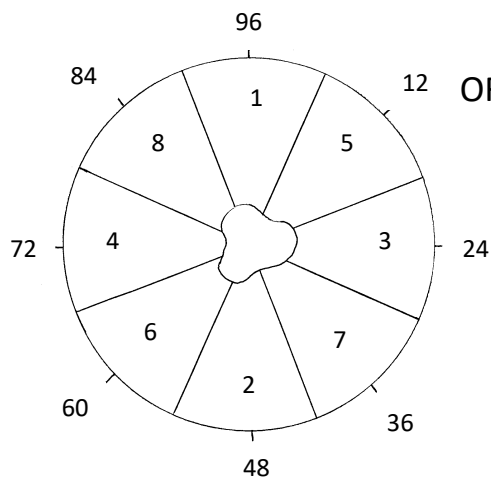
You may also find that the pre-polish lap cuts extremely fast, so watch that you do not cut too deep. The girdle thickness has to be even all way round, otherwise progressive error will result. This may not be apparent until the girdle facets are done.

OK! You have finished the crown mains. Dammed good work! You have come a long way since first putting on the stone to the dop stick. Now come those girdle facets, so lets go.

CUTTING THE CROWN GIRDLES

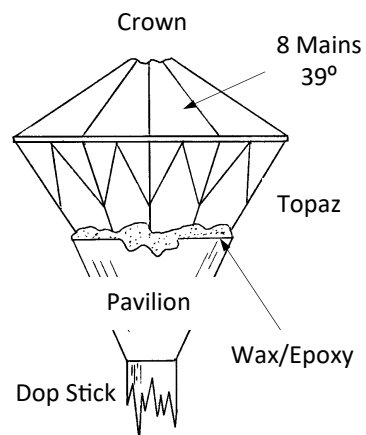
Leave the pre-polish lap on, as this is the lap that you will use, and be cutting the girdle facets. Reset the angle of the protractor to 44°. The angle for girdle facets is normally plus 5° of that of the mains.

Readjust the machine height so that the gem stone just touches the lap. You should be an old hand at this now, and it will come to you automatically. Start cutting the girdle facets as you did for the pavilion. Always adjust the micro height a little bit at a time, and do not try and cut past the stop. - Remember! 'Cut a little, look a lot'. The indexes are the same, and in opposites: 3-93, 45-51, 21-27, 69-75, 9-15, 33-39, 57-63, and 81-87. The completed girdles should look as per the diagram below.



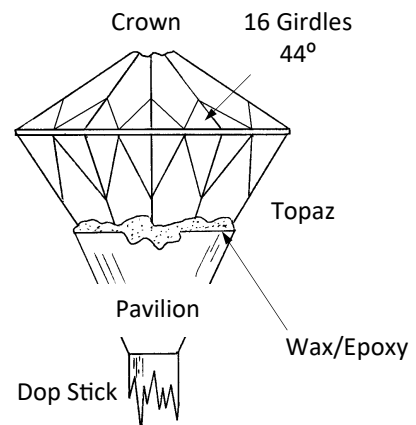
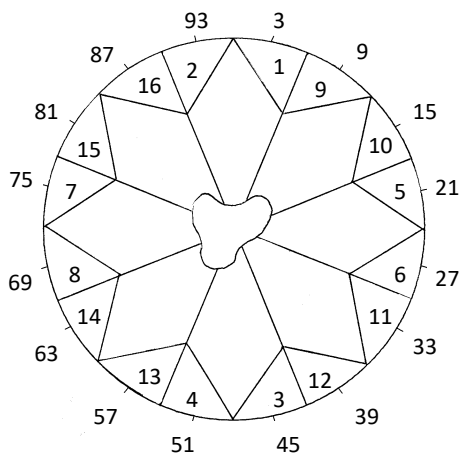
ORDER OF CUTTING

THE 8 COMPLEX



Index No's

ORDER OF CUTTING



So far so good. The girdle and main facets have been done, and all we have to do now is to cut the stars in to meet the girdle facets. Change laps to the coarse one.

CUTTING THE STAR FACETS

The star facets are cut at an angle of 24° . To work out this angle, take away 15° from the main facet. There are eight star facets which are cut so that they meet the apex of the girdle facets, and have a different index number compared to the mains and the girdle facets. These are: 6, 18, 30, 42, 54, 66, 78 and 90 in that order.

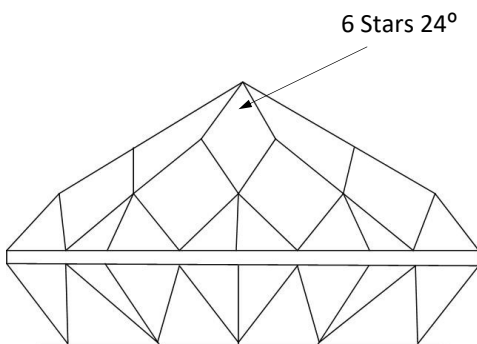
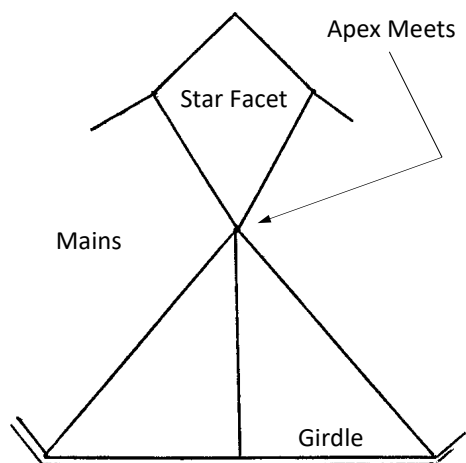
Adjust the angle of the protractor to 24° , and set index to number 6. Set up the height as normal practice, and turn on the machine, and water. Remember the coarse lap is on so the water will need to be at a faster rate.

Lower the quill so that the gem stone just touches the lap, and cut a little, lift up, and look to see what is happening. There should be an inverted triangle or star with its apex coming down to meet the apex of the girdle facet. Caution is required when cutting down to meet other facets as we are using the coarse lap, so you must leave a small amount of material for the pre-polish to cut for the final meets, otherwise you will have to redo the whole crown as the stars would then cut into the girdle facets.

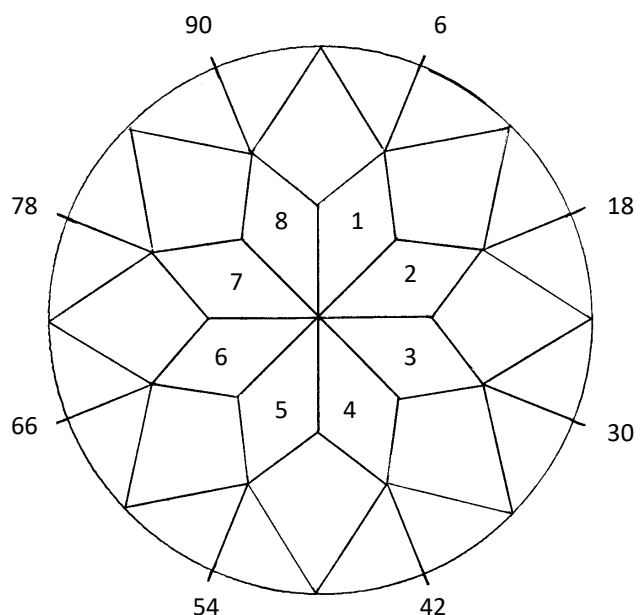
When the first facet is cut close to the girdle apex, change index and do the next set. There will be no need to do opposites, as these star facets are being cut to meet an existing point. All finished, clean the machine thoroughly, and put on the pre-polish lap. Set the quill to

suit the new lap. Don't forget! The index start is 6, and the angle stays the same.

Pre-polish the star facets to meet the girdle facets. Do it slowly as there is only a small amount that need to be cut. Bring the apex of the star facet down to meet the apex of the girdle facet. Good! This technique is commonly known as 'meet point' and is good training for cutting oval brilliants. The finished stars should be as shown below.



ORDER OF CUTTING



POLISHING CROWN FACETS

Set up the polish lap. Did you clean the gem stone and machine?. If not, DO IT NOW!

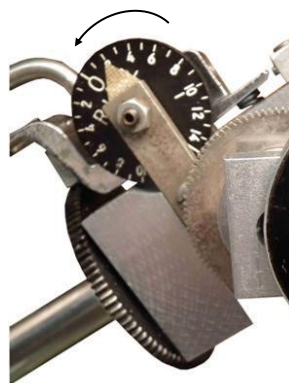
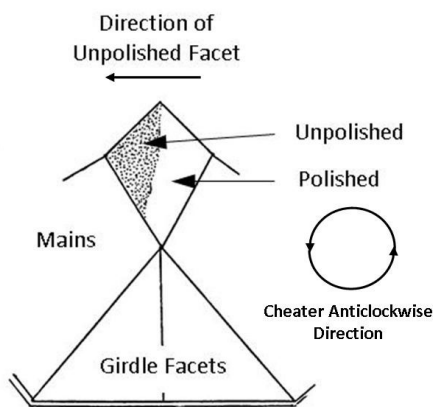
As you have done many times before, set up the stone to the lap. The angle of the protractor does make this one a bit more difficult to set up. Just remember to adjust with the coarse, followed by the micro height adjuster to just touch the lap. Don't forget to release the stop to prevent stress to the quill.

Start the lap on low speed, and proceed to sweep a couple of times across the lap. I presume that you have placed the index on 6 and not some other index. If you have not, you will notice straight away as the gem will either cut into the lap or make one horrible grating noise. No harm should be done to the facet, other than slightly rounding a facet, which you should be able to polish out.

Check the facet. 'Oh Damn! the facet isn't polishing right'. It appears that the facet isn't set right. The polishing is once again showing on the right hand side and slightly down.

This is how you must fix the problem. Look at the polish and determine which way the gem has to rotate to get the left hand side to polish. Yes! That's right! - it's has to move in towards you as you look at it. To do this, turn the index cheater anticlockwise (as with most machines), which brings more of the left hand side in contact with the lap surface.

Redo the facet again across the lap a couple of times and check again. You now should now



see the facet is polishing towards the left hand side now, you may even have to give the cheater another little turn to the left. As you use the cheater, always turn it a small amount. OK! You now have moved the facet closer to the lap and is polishing, but the lower part is still not polishing. As you did once before, if you lower the height of the mast, the bottom of the facet will come in

contact with the lap. Just use the micro height adjuster and give it a nudge so the head lowers a fraction (normally anticlockwise lowers).

Try again, and yes! you have it. Once you have this set up all The other facets can now be done in reverse order - 90, 78, 66, 54, 42, 30, and 18.

The polishing technique just discussed is at most a worse case scenario, and most times after set up there is very little cheating to be done.

Now go ahead and reset the head assembly as if you were going to cut the girdle facets. Angle 44° index 93. Remember don't forget to disconnect the stop after set up.

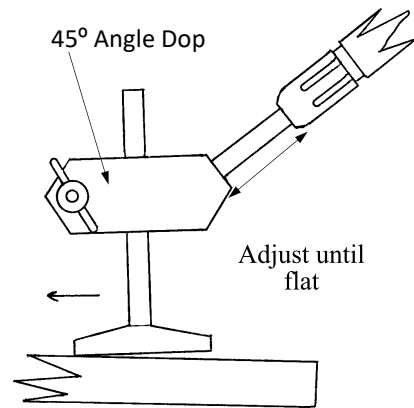
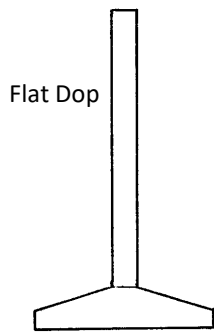
After the girdle facets are done, go ahead and do the main crown facets. You should be an old hand at this now, and find it relatively easy. Angle 39° index 84, **work in reverse order**.

As you were polishing you should have noticed the slight over cuts from the previous polishing now coming back to form the meets of the triangles.

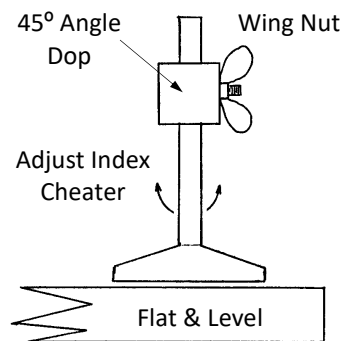
OK! All finished - lets clean up, place the polish lap away, and remove the gem stone/dop stick from the quill.

You have virtually finished the gem stone now, and only require one more facet to do, and that is the crown table. This table is very big and I will be discussing this as another worst case scenario where you will have to use the cheater in both cutting and polishing. This now should be easy for you, and cause you no problems.

SETTING UP THE 45° ANGLE DOP



Lowering Head Assembly Pushes Flat Dop Across and Down so That the Dop Becomes Flat Against the Lap Surface



Select the 45° angle or 'D' dop. When set at 45° on the protractor, the gem stone should be perpendicular to the lap surface (90°), which makes the crown facet parallel with the lap surface, though most 45° angle dops are accurate a lot are not and the following procedure should be used .

Place the flat dop into the 45° angle dop and tighten the nut so the dop stick is held firm. Place the angle dop into the quill, but do not tighten the nut.

Set the angle protractor to say 44°, and index to 96.

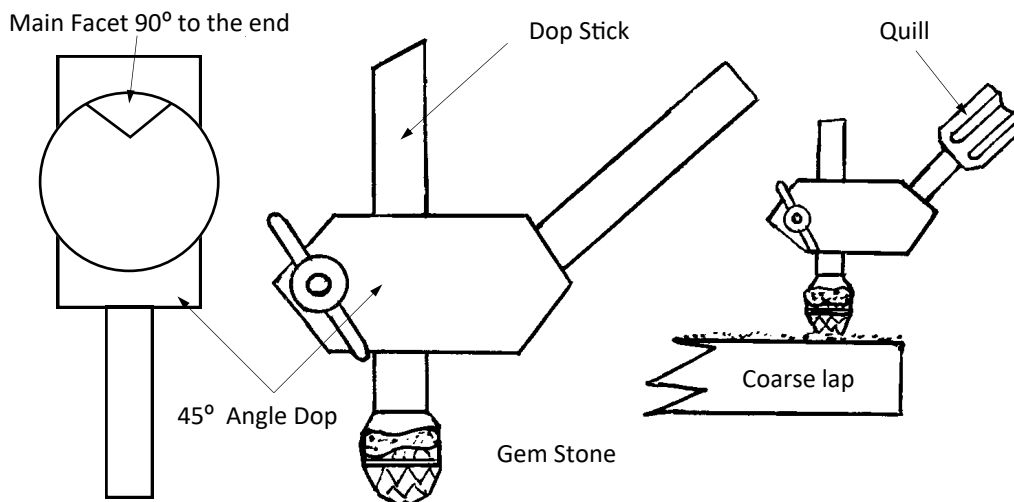
As the crown facet is relatively large go ahead and place the coarse lap on the master lap.

Lower the assembly onto the lap as before, making sure that the angle dop does not fall out of the quill. Lower the flat dop until it lies relatively flat against the lap. Look side on and adjust the height adjuster up/down, and check that all is flat to the surface, and while holding the flat dop against the lap lock the nut on the quill in place. Recheck for flatness and readjust using height adjuster and index

cheaters if required. Now look at the angle and record the reading for future reference (ie it may be 44.5°). Lock the stop in place at 44.5°. The flat dop is now parallel with the lap surface (recheck to be sure).

This technique should be adopted every time you cut a stone, though you can just set the angle to 44.5° now as you have already determined the angle for your transfer jig. This process makes the crown table facet exactly 90° to the girdle.

Lift the quill, and remove the flat dop from the 45° angle dop. Place the gem stone/dop stick assembly in the 45° angle dop and tighten (when fitting the stone into the angle dop, eye ball one of the mains facets so that it is 90° to an end of the angle dop, this will help to keep all the facets in their correct order).



CUTTING THE TABLE FACET

The table facet may look difficult, but is extremely simple, and shouldn't prove to be any problem. The facet will be cut to meet precisely eight only star/girdle facets.

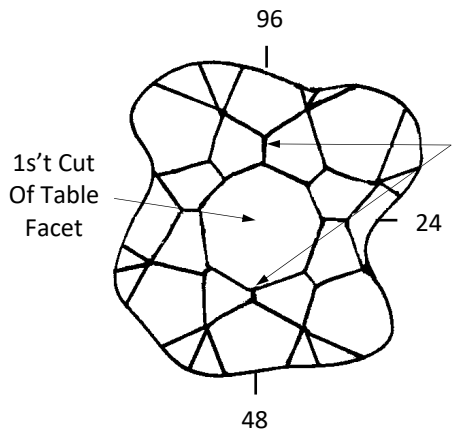
Set up the machine as normal so that the gem stone just touches the lap. Lift off, turn on the water and start the machine. Lower the quill and cut a little. Here you must again use the technique of 'cut a little look a lot', because you can't afford to over cut this facet.

The beginnings of a facet making its way to the points of the girdle star facets should be apparent. Lower the height a fraction and cut a little more - Check. When you have nearly approached the meets, stop and change the lap to the pre-polish lap. Clean up as normal and set the stone to the lap as usual.

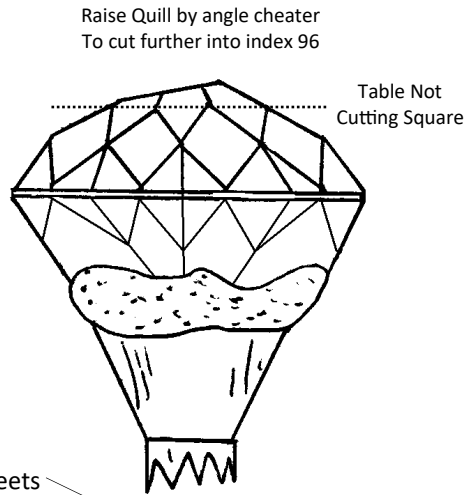
Remember why this is being done? We can't cut directly to the meets as you will certainly over cut when going to the next stage. Always leave short the meets to allow for the next stage.

Lower the quill to lap once again and cut a little. How much further to go! A little more, OK! Cut a little more. Remember you may be cutting past the stop so just watch that all is well here. Are all the points going to meet true? You should be well aware as you get closer to the meets. If not use the cheaters as per page 74. They must all meet simultaneously. You may cut very close to the meets with the pre-polish lap as the polish lap will remove very little of material on such a large facet.

When you have finished the table the stars will be equal-lateral triangles with all the points touching the next facet alongside it.



Points are not going To meet properly. Use The angle cheater to Increase the height and reset



ALL CUTS MUST MEET SIMULTANEOUSLY

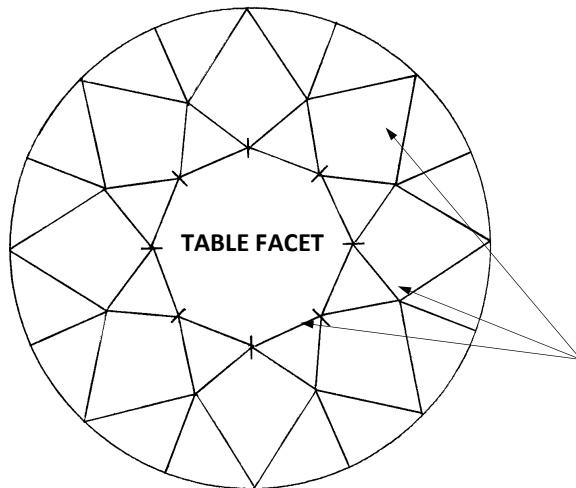
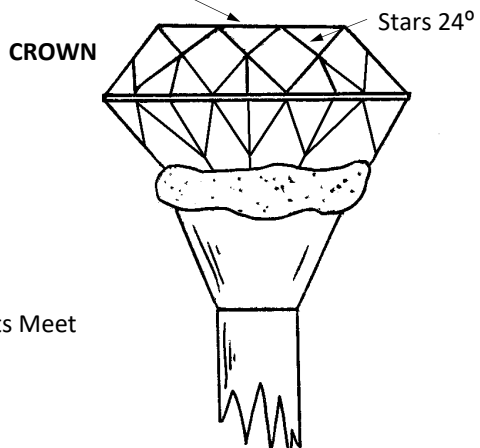


Table Cut to Meets



All Points Meet

POLISHING THE TABLE - This facet may take a little longer to polish because of its large size Set up the polish lap and clean the machine and gem stone. Clean the polish lap and give it a recharge as per chapter 4.

Lower the stone and wipe across the lap and check progress of the polish. Don't forget to release the stop when polishing. Use the index cheater and micro height adjuster to adjust facet to the surface to polish evenly.

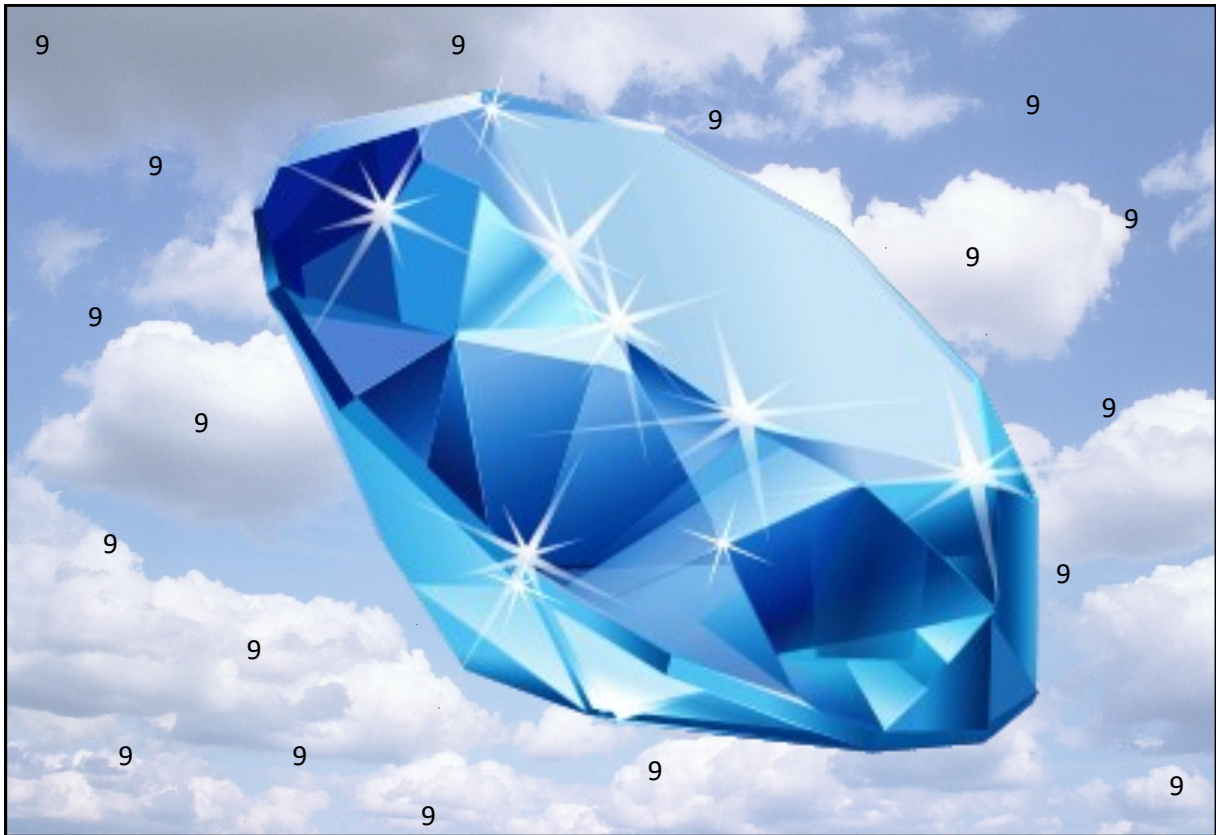
OK! Here comes that scenario I mentioned earlier. The facet does not seem to be polishing. The facet seems to be flaking with slight ripple effect. This is due to polishing on the cleavage (not the girly type). To make the polishing work we are going to hand polish.

Turn the machine off so the lap is not spinning. Wipe the gem stone across the surface of the lap by hand. Check the progress, and you will see a remarkable polish. Keep at it, and your done. It's quite easy and you will acquire your own technique that suits you.

WELL DONE !!!!

Take the stone/dop stick out of the quill and heat the end near the gem stone so you can pry it out. Clean thoroughly with meths and tissue.

Admire the gems beauty of your first cut stone

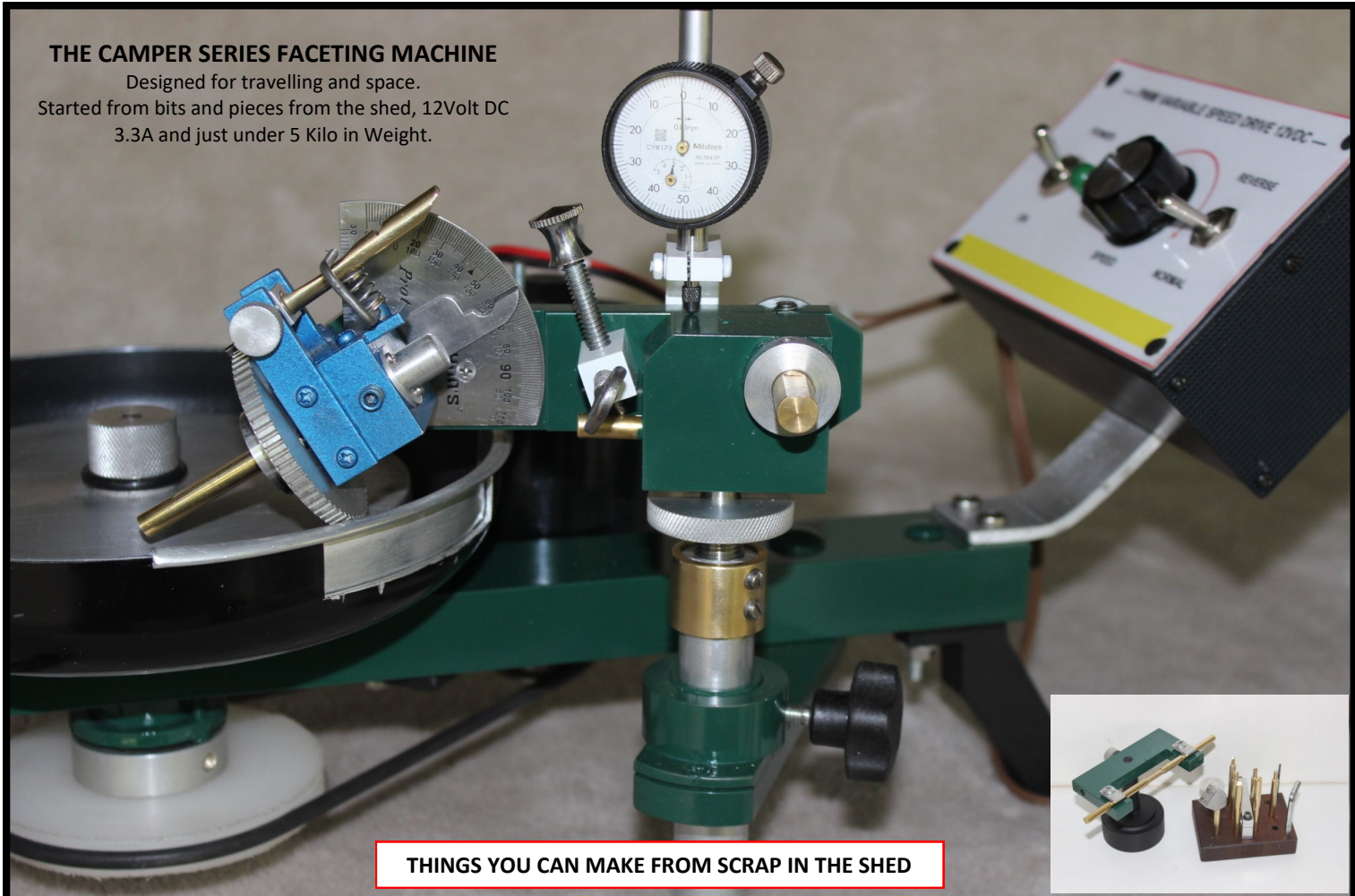


COMMON FACETING MINERAL	MOHS HARD	REFRACTIVE INDEX	Critical Angle°	PAVILION Angle°		CROWN Angle°		
				M	G	M	G	S
Apatite	5.00	1.63	37	42	44	39	44	24
Beryl (Aquamarine & Morganite)	7.5-8.0	1.56	39	43	45	42	47	27
Chrysoberyl	8.50	1.74	34.5	42	44	39	44	24
Corundum [Sapphire] [Synthetic]	9.00 9.00	1.76 1.76	34 34	42 40	44 42	38 38	43 43	23 23
Cubic Zirconia	8.00	2.16	27.4	41	43	35	40	20
Feldspars	5.0/7.0	1.56/1.57	41	43	45	42	47	27
Fluorite	4.00	1.43	44	45	47	43	48	28
Garnet (almandine)	6.0/7.5	1.76/1.83	33.5	41	43	38	43	23
Garnet (Rhodolite - Violet Red)	7.0/7.5	1.75/1.76	31.5	39	41	35	40	20
Garnet (grossular)	6.5/7.0	1.742/1.748	35.5	41	43	38	43	23
Garnet (pyrope - Red)	7.25	1.74/1.75	35	41	43	38	43	23
Moldavite (Obsidian-Glass) Glass & Pastes	5.5/6.0 5.0/6.0	1.45/1.52 1.45 +	41 40	43 43	45 45	42 41	37 36	27 26
Iolite	7.0/7.5	1.53/1.54	40.4	43	45	42	47	27
Lazulite	5.00	1.61	38	41	43	39	42	24
Opal	5.0/6.5	1.44/1.47	43	45	47	41	46	26
Peridot	6.5/7.0	1.65/1.69	37	42	44	39	44	24
Quartz	7.00	1.54/1.553	40	42	44	41	46	26
Spinel	8.00	1.71/1.736	35	41	43	40	45	25
Spodumene	6.5/7.0	1.66	37	41	43	39	44	24
Strontium titanate	6.00	2.41	24.5	41	43	35	40	24
Topaz	8.00	1.61/1.62	37	41	43	39	44	24
Tourmaline	7.0/7.5	1.63/1.65	38	42	44	39	44	24
Yttrium aluminium garnet (YAG)	8.50	1.83	33	40	42	37	42	22
Zircon (high)	6.5/7.5	1.99	31	41	43	35	40	20





HAND CRANKED TEMPLATE FACETING MACHINE FROM YESTERYEAR

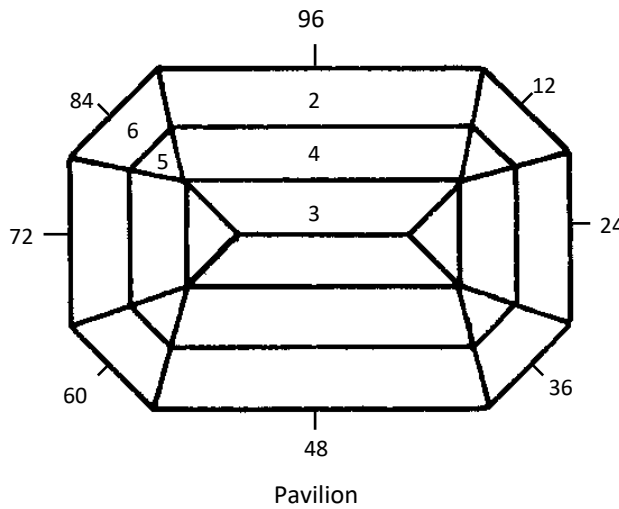


THE CAMPER SERIES FACETING MACHINE

Designed for travelling and space.
 Started from bits and pieces from the shed, 12Volt DC
 3.3A and just under 5 Kilo in Weight.

THINGS YOU CAN MAKE FROM SCRAP IN THE SHED

EMERALD CUT



Angles are for Quartz - Proportion of gem stone best 1.5 to 1 ratio

PAVILION

- (1) Angle 90° Index - 96,48,24,72
- (2) Angle 63° Index - 96,48,24,72
- (3) Angle 43° Index - 96,48,24,72
- (4) Angle 53° Index - 96,48,24,72
- (5) Angle 53° Index - 12,36,60,84
- (6) Angle 63° Index - 12,36,60,84
- (7) Angle 90° Index - 12,36,60,84

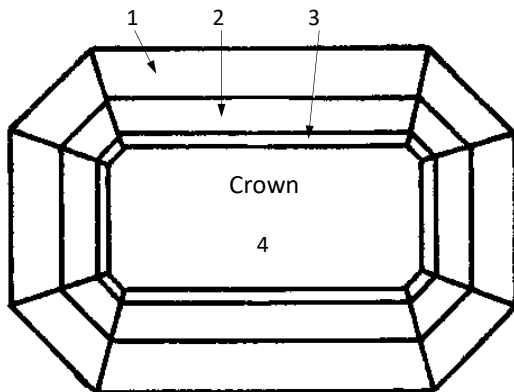
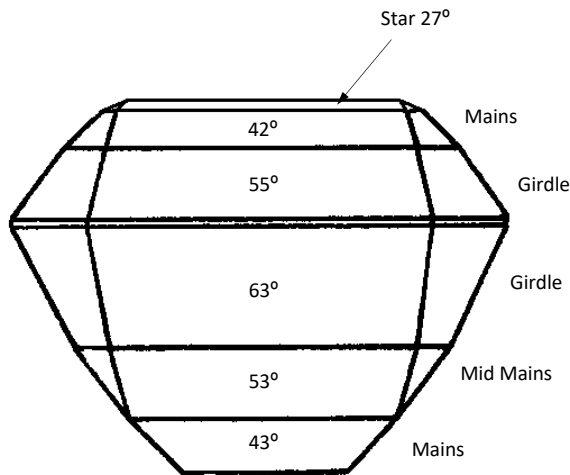
Cut mid way facets and corner facets with 1200 lap and polish reverse order

CROWN

- (1) Angle 55° Girdle
Index - 96,48, 24,72,12,36,60,84
Cut these facets to establish girdle 5%
- (2) Angle 42° Mains
Index - 96,48,24,72,12,36,60,84
- (3) Angle 27° Stars
Index - 96,48,24,72,12,36,60,84

Polish in reverse order

- (4) Table - use 45° angle dop and set up parallel with lap surface. Set angle to 90°, cut and polish

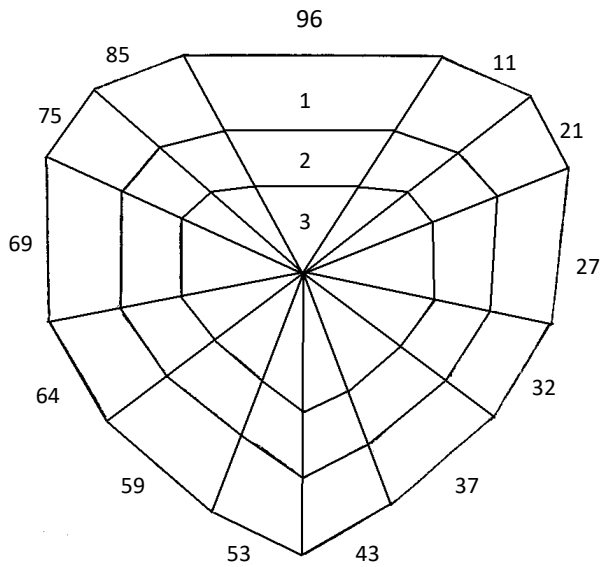


The emerald cut is basically designed for medium to dark coloured stones, or stones with a low refractive index. The depth of the gem stone will enhance lighter coloured stones, but does nothing for scintillation or brilliance.

The only problem that you may encounter with cutting the Emerald Cut, is that you may find that you will have to use the index cheater often, as small amounts of pressure one side or the other of the stone will cause slight over or under-cutting of facets causing un parallel facets. Adjust to get all meets so that the lines are parallel.

By following the above cutting sequences, you should encounter no real problems. Corner facets are cut last and are determined by the angles work out for you. Centre main facets should be cut with the 1200 pre-polish lap if the stones are under 10mm or use the coarse for larger stones.

SPIDERED HEART - Step Cut 79 Facets 96 Index

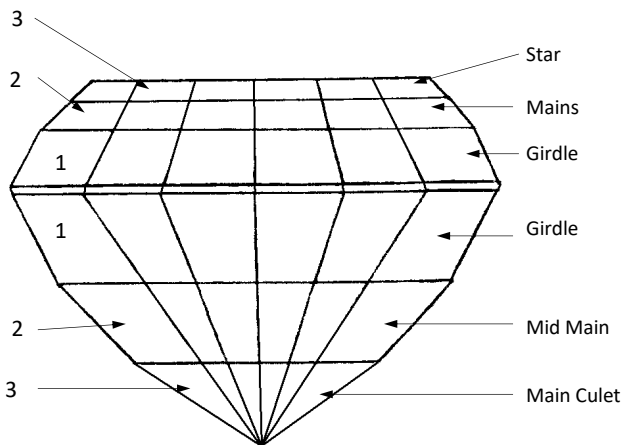


Angles are for Quartz:

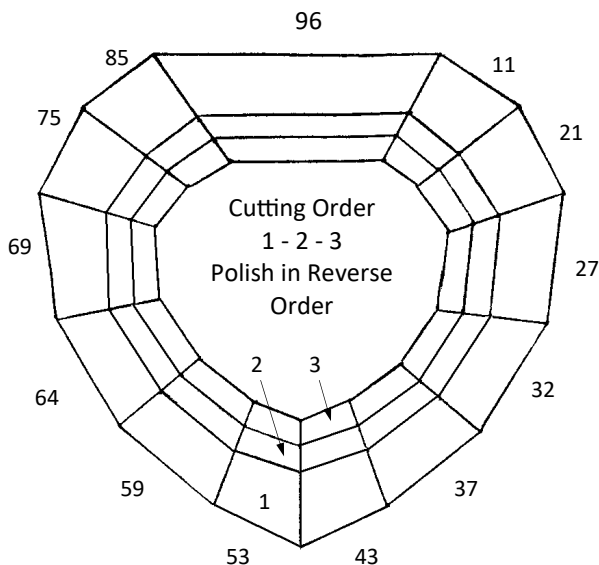
PAVILION

- (1) 63° index as marked
- (2) 53° index as marked
- (3) 43° index as marked

Polish in reverse order



This type of step cut can be used for just about all shapes and sizes. Particularly suited to medium to dark stones, especially garnets.



Angles are for Quartz:

CROWN

- (1) 52° index as marked
- (2) 42° index as marked
- (3) 27° index as marked

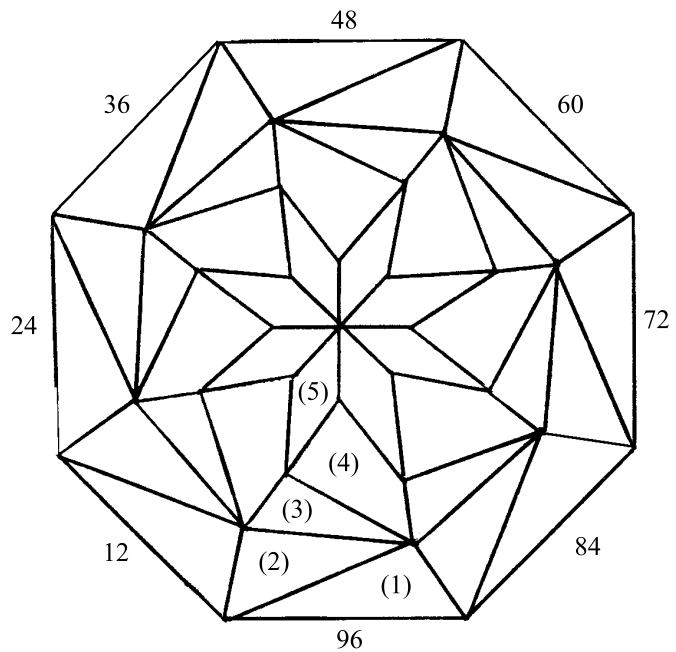
Polish in reverse order

Cut and polish table last using 45°
Angle dop

'OLLEN' cut - Designed by Trevor Hannam

PAVILION

- (1) 55° 96-12-24-36-48-60-72-84
- (2) 50° 01-13-25-37-49-61-73-85
- (3) 48° 01-13-25-37-49-61-73-85
- (4) 44° 96-12-24-36-48-60-72-84
- (5) 40° 06-18-30-42-54-66-78-90



A TWIST WITH A DIFFERENCE

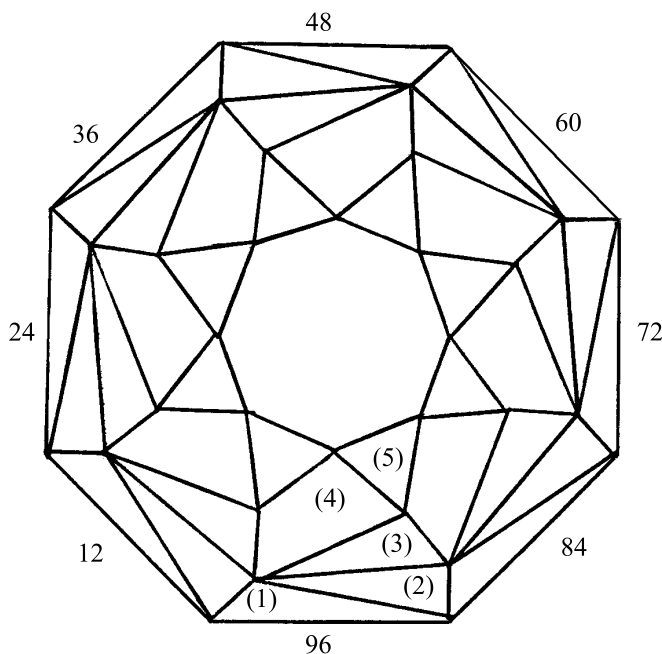
Angles shown are for topaz - R.I. Stones of 1.6 to 1.7.

The cut produces some interesting patterns with scintillation, and does appear to suit coloured stones. Square the stone (rounding), indexing 96-12-24 etc. Follow the sequences shown, and there should be no trouble.

*NOTE - Table is cut last

CROWN

- (1) 60° 96-12-24-36-48-60-72-84
- (2) 50° 95-11-23-35-47-59-71-83
- (3) 45° 95-11-23-35-47-59-71-83
- (4) 35° 96-12-24-36-48-60-72-84
- (5) 28° 06-18-30-42-54-66-78-90



CHAMPAGNE GLASS - Designed by Trevor Hannam

This design can be rounded or cut direct from rough material with no pre-form. Angles will suit all gems as brilliance is not the object here. Cairngorm or slight smoky quartz gives a very realistic finish to the glass - You'll be amazed how easy it is. Indexes can be altered to produce diamond shape facets instead of the rectangular type facets.

CROWN

- Step 1** 75° Indexes 96-06-12-18-24-30-36-42-48-54-60-66-72-78-84 and 90
- Step 2** 40° Indexes 96-06-12-18-24-30-36-42-48-54-60-66-72-78-84 and 90
- Step 3** Polish in reverse order
- Step 4** Cut Table on the 45° angle dop to approximately 70-90% - 85% is good
- Step 5** Polish Table and then transfer - Use a medium size dop stick and put aside.

STEM

A piece of quartz crystal is best used as it is basically round and long. Determine the length required by measuring the width, and using 60% of the width for the length.

The champagne stem is tapered (large end on the dop stick). Round the stem with 15% of the total crown diameter

- Step 1** 86° Indexing 96-06-12-18-24-30-36-42-48-54-60-66-72-78-84 and 90
- Step 2** Polish
- Step 3** Cut the tapered stem flat with 1200 pre-polish, using the 45° angle dop. This will accommodate the base (bottom bit) of the glass.
- Step 4** Transfer to a cone dop stick and put aside.

The stem is a bit tricky due to its length and small diameter - Polish carefully

PAVILION - (BOWL)

- Step 1** 75° Indexing 90-06-12-18-24-30-36-42-48-54-60-66-72-78-84 and 90
- Step 2** 50° Indexing 90-06-12-18-24-30-36-42-48-54-60-66-72-78-84 and 90
- Step 3** 35° Indexing 90-06-12-18-24-30-36-42-48-54-60-66-72-78-84 and 90
- Step 4** 20° Indexing 90-06-12-18-24-30-36-42-48-54-60-66-72-78-84 and 90
- Step 5** 10° Indexing 90-06-12-18-24-30-36-42-48-54-60-66-72-78-84 and 90

All Facets should come to a point

Step 6 Using the 45° angle dop, cut a small flat facet with the 1200 pre-polish lap to match the width of the stem. This is the targets part of the stem (15%).

Step 7 Place glass and stem dops in the transfer jig, align and using 24 hour araldite or Loctite UV cement (requires UV light to set), push together and leave aside for 24 hrs. With The UV cement, leave in the sunlight for 30 minutes to set.

Step 8 Remove fixture from the transfer jig and take the dopstick off the end of the stem only.

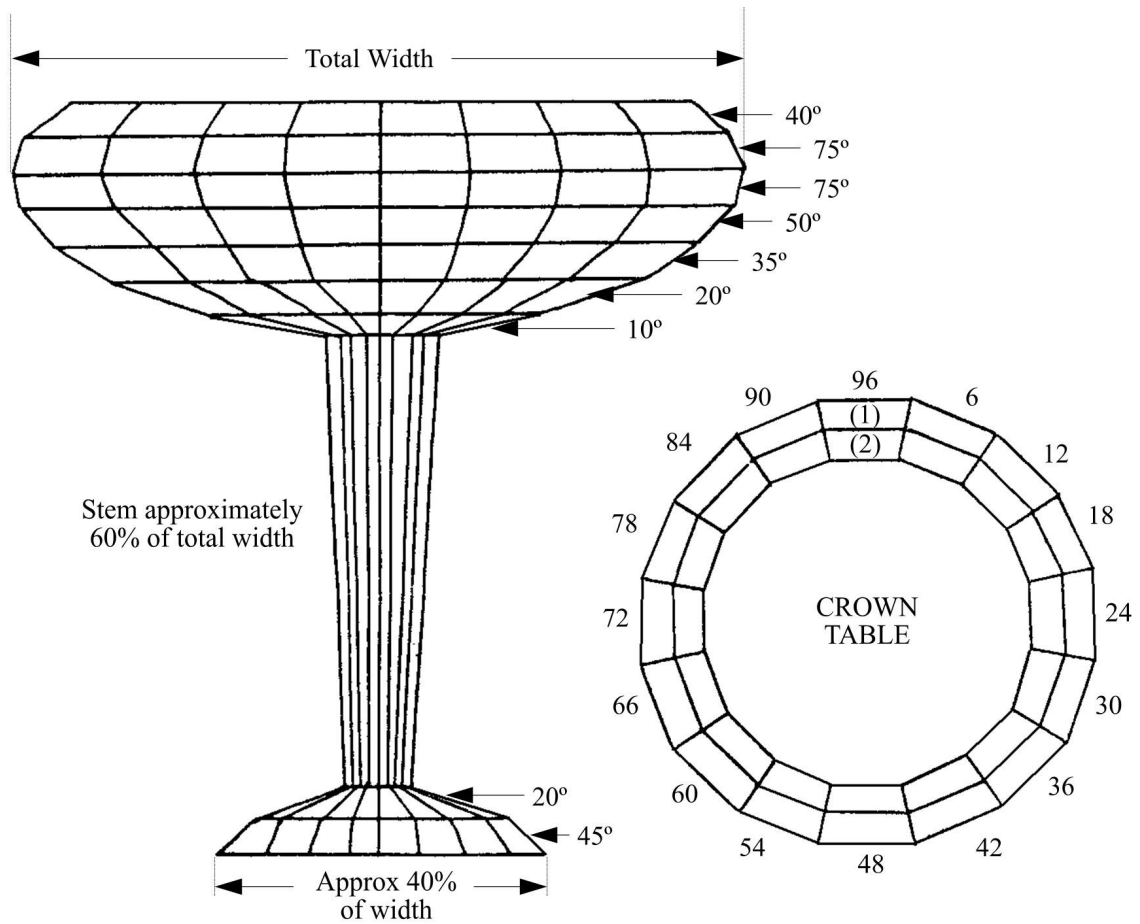
Step 9 Using the 45° angle dop, cut a flat surface with the 1200 pre-polish lap

BASE

- Step 1** Round a stone to approximately 50% of total width using coarse lap only.
- Step 2** Using 45° angle dop, cut a flat table, polish and transfer
- Step 3** 45° Indexing 90-06-12-18-24-30-36-42-48-54-60-66-72-78-84 and 90. Cut this down so the diameter is approximately 45% of total crown width
- Step 4** 20° Indexing 90-06-12-18-24-30-36-42-48-54-60-66-72-78-84 and 90.

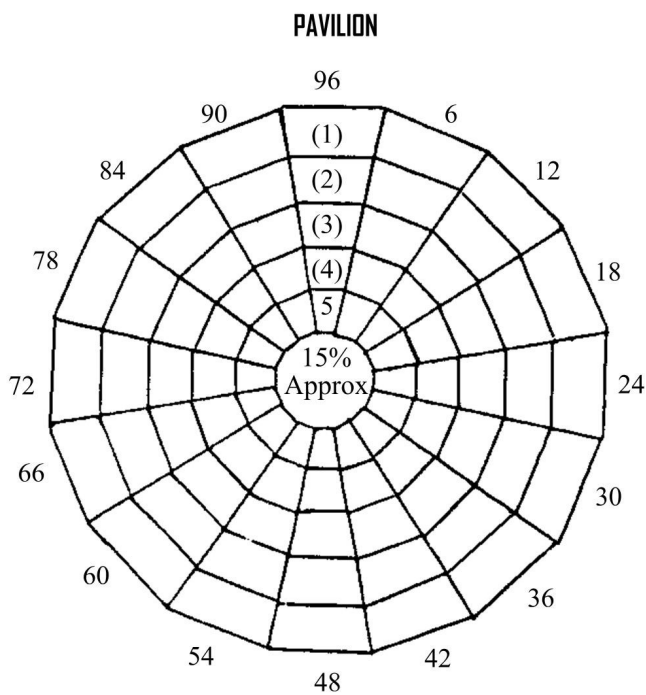
All Facets should come to a point

Step 5 Using 45° angle dop, cut a flat on the 1200 pre-polish lap to match narrow width on the stem. Using the transfer jig, place glass and stem together, and align. Cement as above and remove from jig when set. Clean up with meths and tissue.

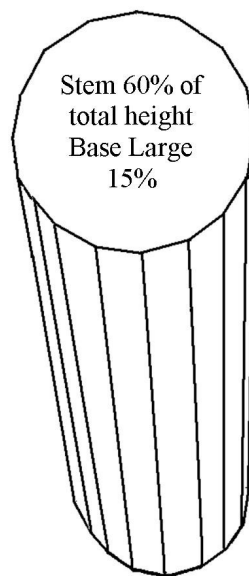


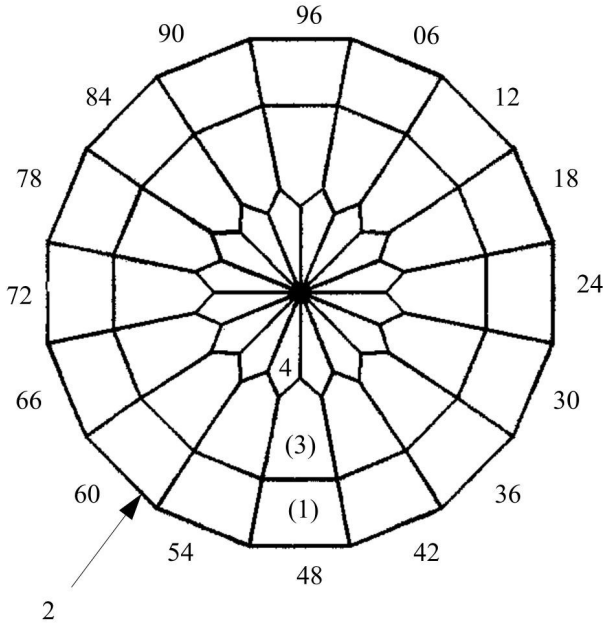
Kaytre Cut/2 - 'Champagne Glass' designed by Trevor Hannam

CROWN



STEM

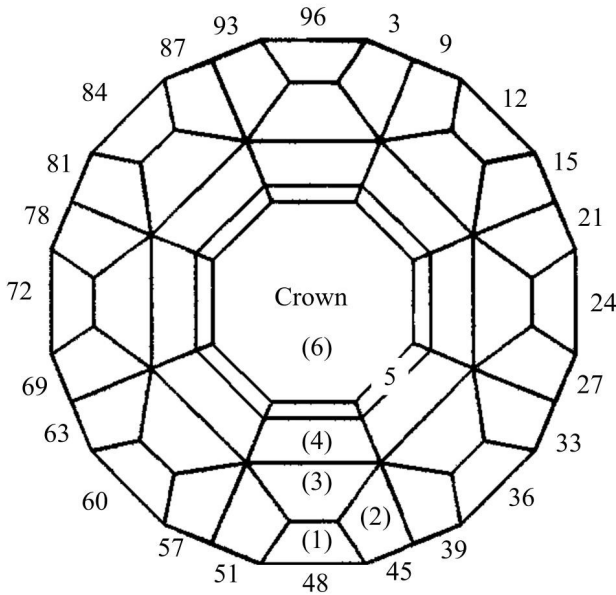




15:6 KAYTRE CUT
 Designed by Trevor Hannam
 Angles are for quartz
 113 facets - 96 index wheel

PAVILION

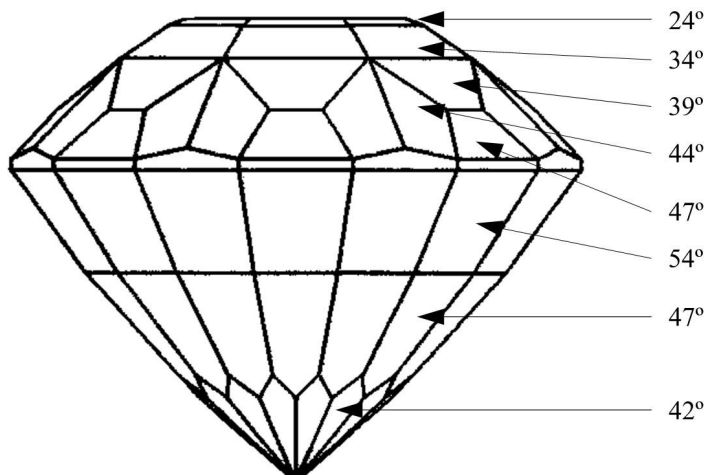
- (1) 54° Indexing:
96-6,12-18,24-30,36-42,48-54,60-66,72-78,84-90
- (2) 90° Indexing:
Use the same index as No 1
- (3) 47° Indexing:
Use the same index as No 1
- (4) 42° Indexing:
3-9,15-21,27-33,39-45,51-57,63-69,75-81,87-93



CROWN:

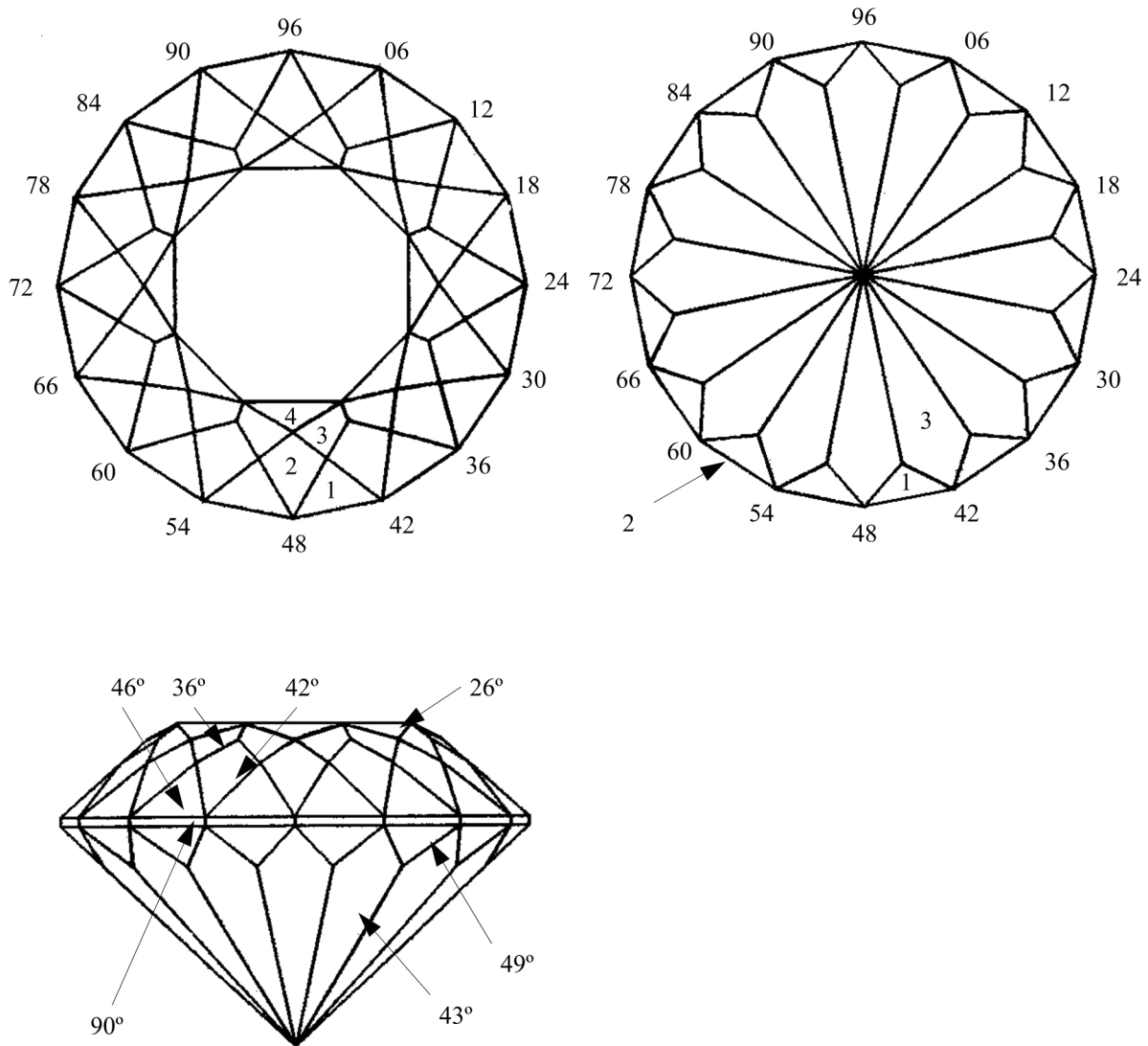
- (1) 47° Indexing:
96-12-24-36-48-60-72-84
- (2) 44° Indexing:
3-9,15-21,27-33,39-45,51-57,63-69,75-81,87-93.
- (3) 39° Indexing:
96-12-24-36-48-60-72-84
- (4) 34° Indexing:
96-12-24-36-48-60-72-84
- (5) 24° Indexing:
96-12-24-36-48-60-72-84
- (6) Table done last Use 45° angle dop, cut and polish

Polish In Reverse Order



You may notice that the facets (39°) on the girdle, Index 3-9,15-21, etc Are slightly raised, leaving a slight uneven girdle.
 If this proves a problem, cut a small triangular facet on indexes 6,18,30,42,54,66,78,90.
 Cut to even girdle and to meet with No. 3/4 Apex

KAYTRE 5 - Designed by Trevor Hannam
 105 facets use 96 Index Wheel
 Angles are for quartz



PAVILION:

- (1) 49° Indexing: 3-9,15-21,27-33,39-45,51-57,63-69,75-81,87-93
- (2) 90° Index as above to form the girdle
- (3) 43° - Index 96,6,12,18,24,30,36,42,48,54,60,66,72,78,84,90

CROWN:

- (1) 46° - Index 3,9,15,21,27,33,39,45,51,57,63,69,75,81,87,93
- (2) 42° - Index 96,6,12,18,24,30,36,42,48,54,60,66,72,78,84,90
- (3) 36° - Index 3,9,15,21,27,33,39,45,51,57,63,69,75,81,87,93
- (4) 26° - Index 96,12,24,36,48,60,72,84
- (5) Table using 45° angle dop - Cut and polish

POLISH IN REVERSE ORDER

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