

Creating Cabs with a Flat Lap

Preface

Each lapidarist must decide for themselves which type of machine they prefer, the flat lap or a vertical machine (i.e. Cap King). I chose the flat lap, and this presentation documents my method of creating cabochons using my flat lap machine. I hope it helps those who also choose the flat lap.

Making cabochons requires patience and finesse. It is NOT a “brute force” kind of craft. I would strongly advise that if uncertainty exists as to which grit wheel to use, use the finer grit wheel. Take your time. Educate yourself as to the stone you are working. Check for hardness, brittleness, cleavage, and susceptibility to heat and/or chemicals (i.e. acetone). Do not use high pressure when contacting stones to grinding wheels, especially with softer or brittle stones. Check the progress of your grinds frequently. Once you grind material away, you cannot put it back.

Do not let the length of this presentation bother you. I am starting with a dirty rock that has not been worked or slabbed, and choosing to fit it in a specific setting. If you start with a slabbed and/or trimmed stone or choose to do a free form shape, the process becomes easier and shorter.

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Introduction - Machine

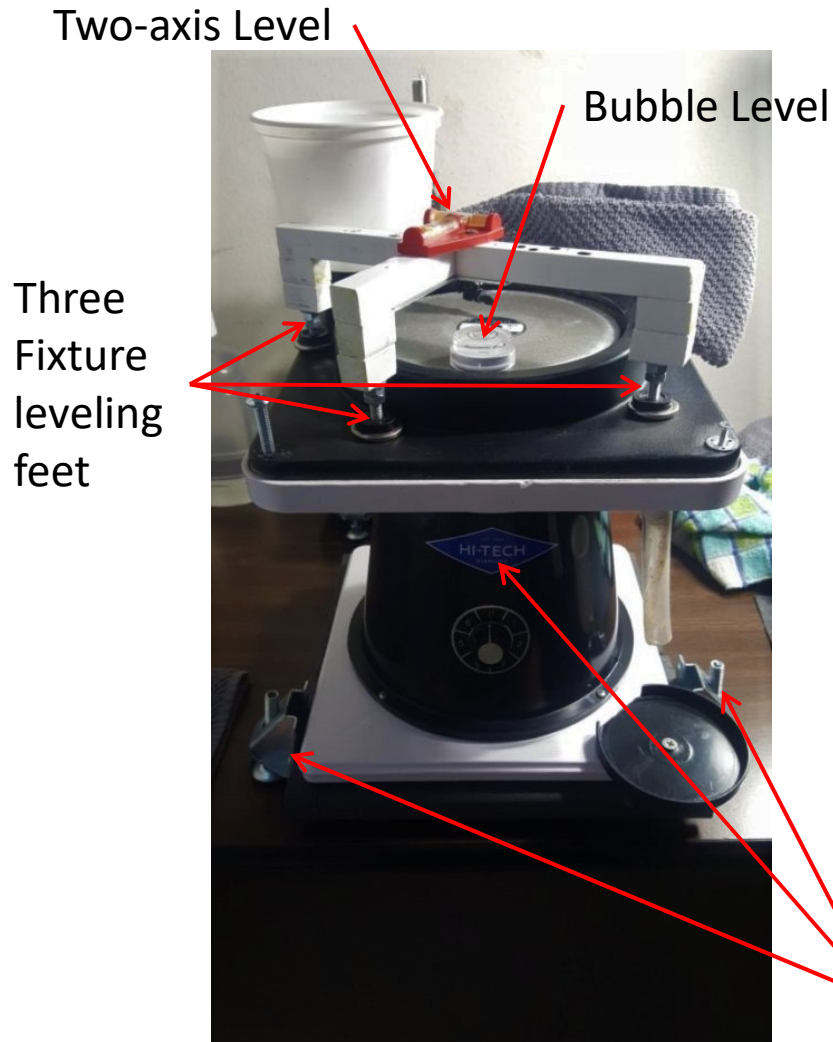


My machine is a 6 inch flat lap from Hi Tech. I selected a flat lap for a variety of reasons:

1. Price (about 1/3 that of a Cab King)
2. Smaller Foot Print
3. Easy to transport
4. Can create flat surfaces (tables)
5. Can create uniformly thick stones that make creating the dome a bit easier
6. Far less water spray on user and surroundings
7. Already half way to faceting setup
8. Easy to built fixture for making repeatable angle cuts with all grit wheels (see next slide)
9. Wide range of grit wheels could be used with just a fast and easy change

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Introduction - Fixture



I designed and built a fixture that would sit on top of the bezel. This fixture enables me to make repeatable grinds of 45°, 30°, and parallel to dop stick mounted surface. To set up the fixture for use, follow the procedure below.

1. Use bubble level and adjust flat lap leveling feet (3 total) to achieve level grit wheel surface. One of these feet is behind the machine.
2. Use the two-axis level on fixture to achieve level fixture by adjusting the three fixture feet. The purpose of the fixture will be discussed later.

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Introduction – Grinding Wheels



1



2



3



4



5

I have four sets of 6" grinding wheels:

1. Metal Shaping wheels: 80, 160, 325, 600, 1200, and 3000 grits. Use a single backing disk by interchanging each wheel.
2. Smoothing wheels with cushion padding: 325, 600, 1200 and 3000 grits. Each of these are mounted on a dedicated backing disk.
3. Smoothing wheels without cushion padding: 325, 600, and 1200 grits. Each of these are mounted on a dedicated backing disk.
4. Polishing wheels: felt surface w/aluminum oxide, pre-charged w/cerium oxide, mole skin w/aluminum oxide.
5. Alternate Polishing wheels: 8000 and 14000 grits. Each of these are also mounted on a dedicated backing disk.

The use and purpose of each type of wheel will be discussed later.

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Rock Orientation for Features



“A” Side

The stone used in this presentation is a Gneiss (pronounced NICE as in “this is a nice stone”), a metamorphic rock, primarily composed of layers of granite, quartz, feldspar, and biotite mica. It is easily found on railroad tracks and in some campgrounds. It has a hardness of 7, and typically does not fracture easily. Also, does polish pretty well.



“B” Side

Examine the stone and select the “A” side (dome side) and “B” side (side for dop stick mounting). Use the natural features and shape of the stone to determine the best location for the cabochon dome. My choices are shown below.

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Grinding Flat Surface for Dop



Before

Next, determine where to grind the flat surface for dop stick mounting. Minimize waste as best you can. For this stone, I choose to grind a flat at the red line location to maximize cab size and minimize waste.



After



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Tracing Shape of Cabochon and Attaching the Dop Stick



Trace the chosen shape of the cab on the “B” side surface. I mainly do ovals, because I can buy settings to mount them since I am not into wire-wrapping or silver-smithing. Also, I wanted to use an oval for this presentation because it is more involved process than is a free shape. Use the stone’s natural features and shape to determine best location and size of tracing. Be careful not to place tracing under any thin sections of the stone. Must have sufficient thickness to create the cabochon dome. Typically, proper location of the shape will result in a significant amount of waste.



Attach the dop stick to the “B” side. You can use one of two methods:

1. **Super Glue:** I use this on stones that can stand the soaking in Acetone to remove the dop stick when the cabochon is complete. Usually, stones with hardness of 7 or better work good for that. The acetone can discolor some softer/porous stones.
2. **Dop Wax:** This works well with stones that can stand the heat required to mount the dop stick. Removing the stone from the dop is very easy. Just sit it in freezer for 5 to 10 minutes, and the dop stick pops right off.



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Stage 1 – Perimeter Grinding



I use my left hand to rotate the stone, while my right hand keeps the dop stick horizontal and allows it to rotate in my fingers. Using the 160 grit wheel, I ground the perimeter to be close to the shape outline. The top surface of the stone was also ground to be somewhat parallel to the surface where the dop stick is mounted (personal preference). The 160 wheel is good for stones of this hardness and toughness. Others may require a finer grit, such as the 325. Later on, I will clean up this surface to be much closer to parallel. The reason for this will be illustrated in later slides.



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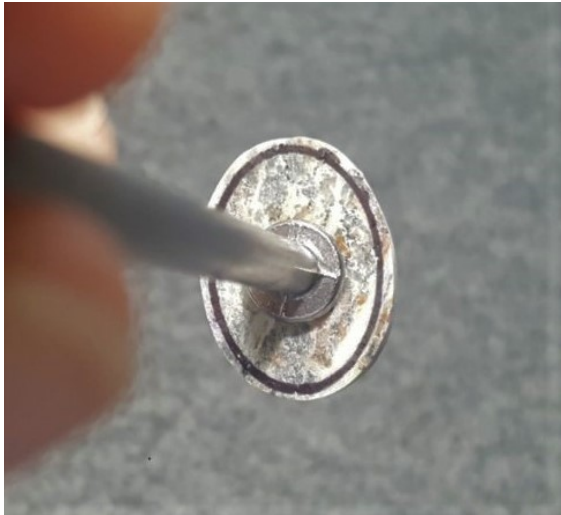
Stage 1 - Perimeter Grinding (con't)



After grinding Stage 1 with the 160 grit metal shaping wheel, check the fit of the stone with the setting. At this point, it should be larger than the setting by a small amount.

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Stage 2 - Perimeter Grinding



Repeat the procedure shown in Stage 1 using the 325 grit metal shaping wheel. After grinding Stage 2, check the fit of the stone with the setting again. It should be closer but still larger than the setting.

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Stage 3 - Perimeter Grinding

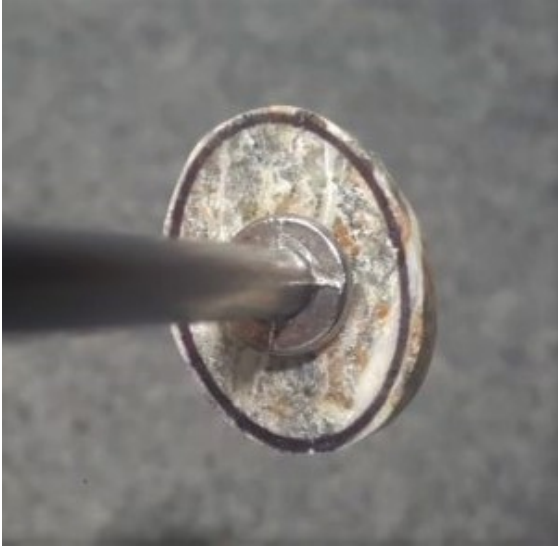


Repeat the procedure shown in Stage 1 using the 600 grit metal shaping wheel. During grinding Stage 3, check the fit of the stone with the setting frequently. This will tell you where you should work on the perimeter. Continue this until the stone needs to be mildly forced to fit completely into the setting. Ensure the “B” side makes contact with the entire setting perimeter lip.



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Stage 4 - Perimeter Grinding



Repeat the procedure shown in Stage 1 using the 1200 grit metal shaping wheel.

During grinding Stage 4, again check the fit of the stone with the setting frequently. This will tell you where you were on the perimeter you should work. Continue this until the stone easily fits into the setting, but without gaps between stone and setting. Ensure the “B” side makes contact with the entire setting perimeter lip.



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Stage 5 - Perimeter Grinding

Stage 5 grinding with the 3000 grit metal shaping wheel is optional. I usually stop after the 1200 grind. If you choose to do Stage 5 grinding, repeat the procedure shown in Stage 4 using the 3000 grit metal shaping wheel, and be sure not to create significant gaps between stone and setting.

Now that the setting fit is good, no more shaping wheels will be used on the perimeter. Later, more will be done on the perimeter using the finer grit smoothing and polishing wheels.

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Parallel Surface to the Dop Stick Mounting Surface

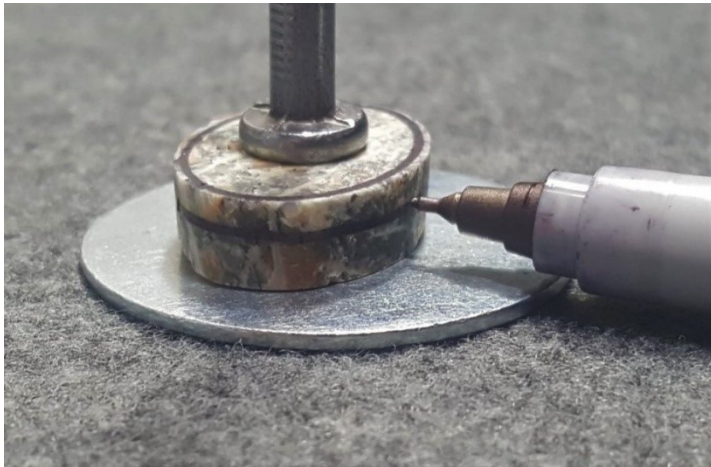


Now I grind the “A” side to be parallel to the dop stick mounting surface. I usually use the 160 grit metal shaping wheel for this operation. It may be better to use the 360 grit for softer or more brittle stones. Use the fixture leveling process described on Slide 3, then place the dop stick in the 90° hole on the fixture and hold the fixture steady while rotating the stone. The distance between the parallel surfaces will vary depending on the surface area to be domed and upon how high you want the dome to be. Usually, 7 to 10 mm is good. I use a micrometer to measure stone thickness in several locations. Continue until measurements at all locations are reasonably close to each other.



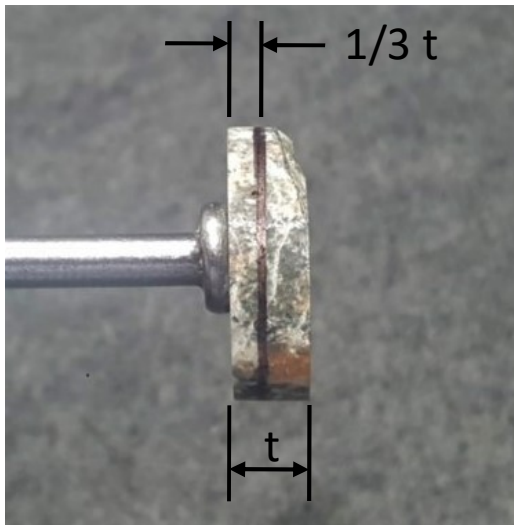
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Marking the 45° Bevel Limit Line



After creating these surfaces, then a line can be drawn around the perimeter. That will be the stopping point for the 45° bevel cut. The parallel surfaces make this line a uniform distance down from the dop mounted surface around the perimeter of the stone.

I use some washers to position the marker or stone at the desired location. Then, I rotate the stone while holding the pen steady to make a mark around the perimeter of the stone. The distance from the dop mounting surface to this line will depend on the stone and its size, but about $1/3$ the thickness of the stone is a good rule of thumb.



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Grinding the 45° Bevel



The 45° bevel grind begins the dome shaping process. I usually use the 160 grit metal shaping wheel for this process. Again, it may be better to use the 360 grit for softer or more brittle stones.



Use the fixture leveling process described on Slide 3. Place the dop stick in the 45° hole on the fixture and hold the fixture steady while rotating the stone. Examine frequently as you approach the marked line. Grind the 45° bevel until the lower end touches the line. You now have the beginnings of the cabochon dome.

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Grinding the 45° Bevel (con't)



About half way to the marked line.



A completed 45° bevel cut.

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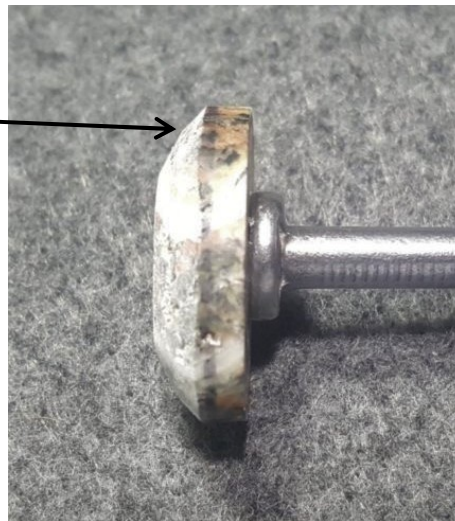
Grinding the 30° Bevel



A 30° bevel cut is now done to complete the pre-dome grinding, still using the 160 grit metal shaping wheel. Again, use the fixture leveling process described on Slide 3. Place the dop stick in the 30° hole on the fixture and hold the fixture steady while rotating the stone. Examine frequently as you go. Continue until this cut is about half to two thirds to the end of 45° cut.

Angle change →

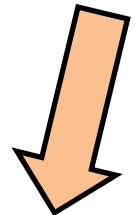
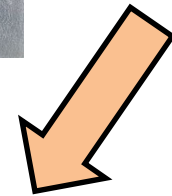
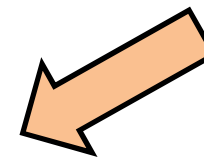
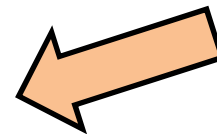
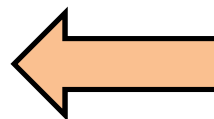
A completed 30° bevel cut. The change in the angle is visible, but a bit difficult to see.



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Stage 1 – Dome Shaping

The doming process now begins, still using the 160 grit metal shaping wheel. This part is done by hand, rotating the stone as you grind. Do not let the stone leave the grinding surface. Keep it moving at all times. Apply steady but medium pressure. Examine frequently as you go. I rotate the dop as I slide across the wheel, changing the angle with the wheel as it slides. This is something that each lapidarist can personalize.

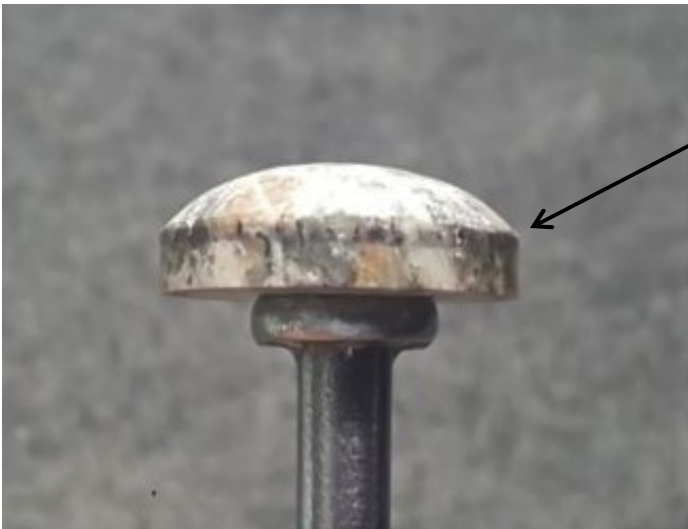


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Stage 1 – Dome Shaping (con't)



Check the progress of the shaping frequently. Ultimately, you want to achieve a uniformly symmetric dome in both axes.

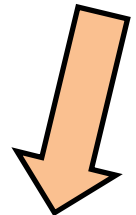
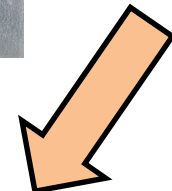
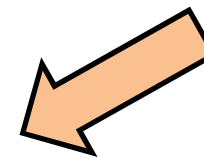
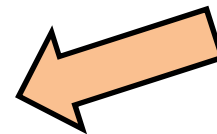
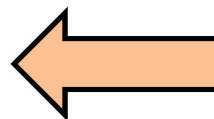


Recommend to not “break” these sharp edges. This is best done using a finer grit wheel.

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Stage 2 – Dome Shaping

Perform the same procedure using the 325 grit metal shaping wheel. Just as before, do not let the stone leave the grinding surface. Keep it moving at all times. Apply steady but medium pressure. Examine frequently as you go. As before, I rotate the dop as I slide it across the wheel, changing the angle with the wheel as it slides.



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Stage 2 – Dome Shaping (con't)



Check the progress of the shaping frequently. Still want to maintain the uniformly symmetric dome in both axes.

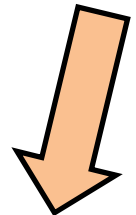
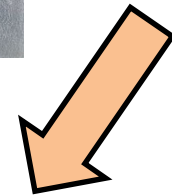
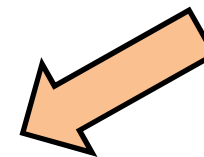
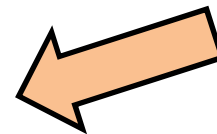
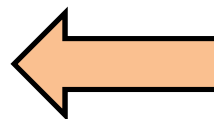


Recommend to not “break” these sharp edges. This is best done using a finer grit wheel.

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Stages 3 and 4 – Dome Shaping

Perform the same procedure using the 600 and 1200 grit metal shaping wheels. Just as before, do not let the stone leave the grinding surface. Keep it moving at all times. Apply steady but medium pressure. Examine frequently as you go. As before, I rotate the dop as I slide it across the wheel, changing the angle with the wheel as it slides.



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Stages 3 and 4 – Dome Shaping (con't)



Check the progress of the shaping frequently. Still want to maintain the uniformly symmetric dome in both axes.

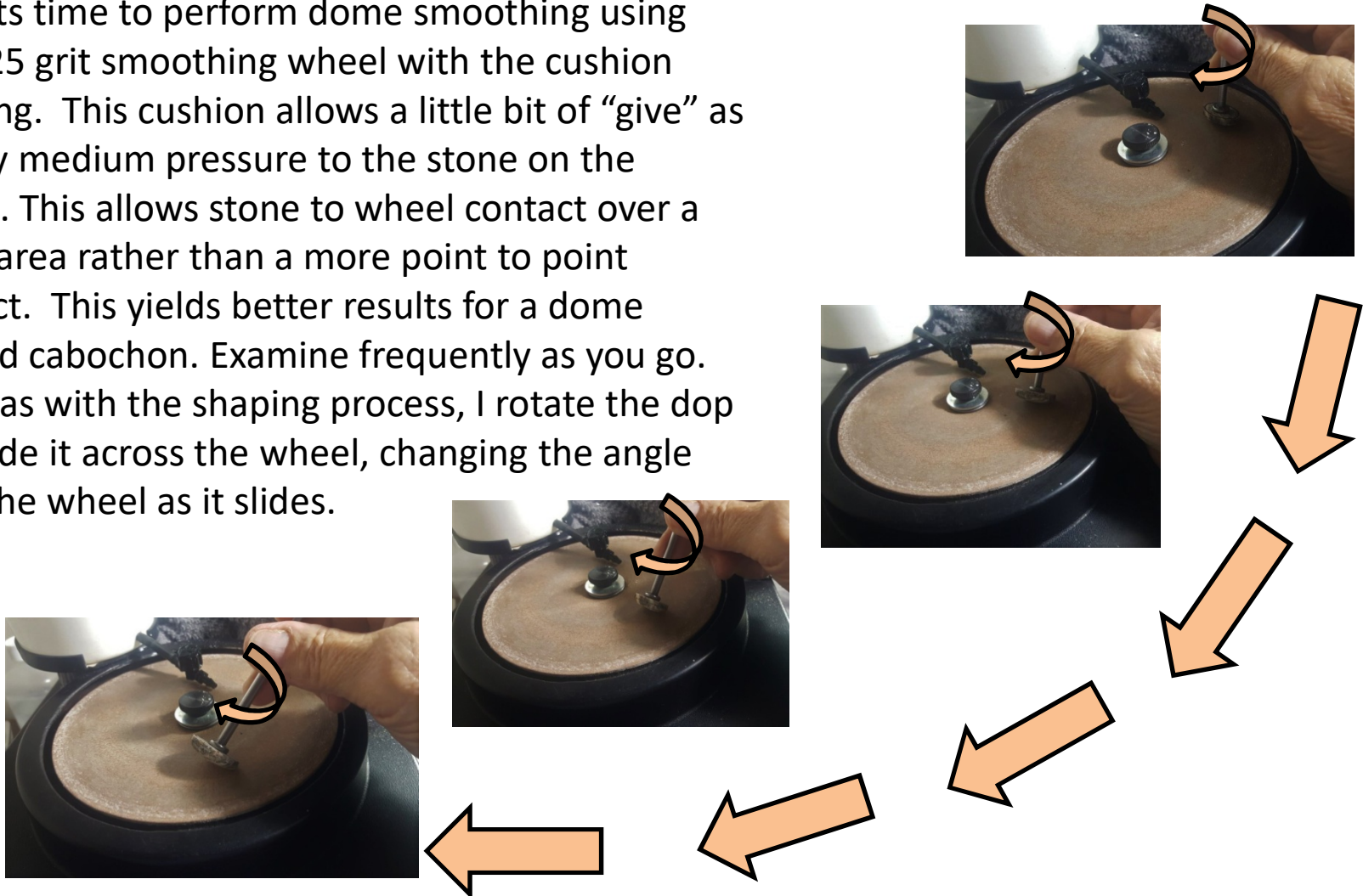


Sharp edges can be “broken” with either of these grits. For this stone, I used the 600 grit wheel to do this. Softer stones would likely do best using the 1200 grit wheel.

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Stage 1 – Dome Smoothing

Now its time to perform dome smoothing using the 325 grit smoothing wheel with the cushion padding. This cushion allows a little bit of “give” as I apply medium pressure to the stone on the wheel. This allows stone to wheel contact over a small area rather than a more point to point contact. This yields better results for a dome shaped cabochon. Examine frequently as you go. Same as with the shaping process, I rotate the dop as I slide it across the wheel, changing the angle with the wheel as it slides.



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Stage 1– Dome Smoothing (con't)



Check the progress of the shaping frequently. Still want to maintain the uniformly symmetric dome in both axes.

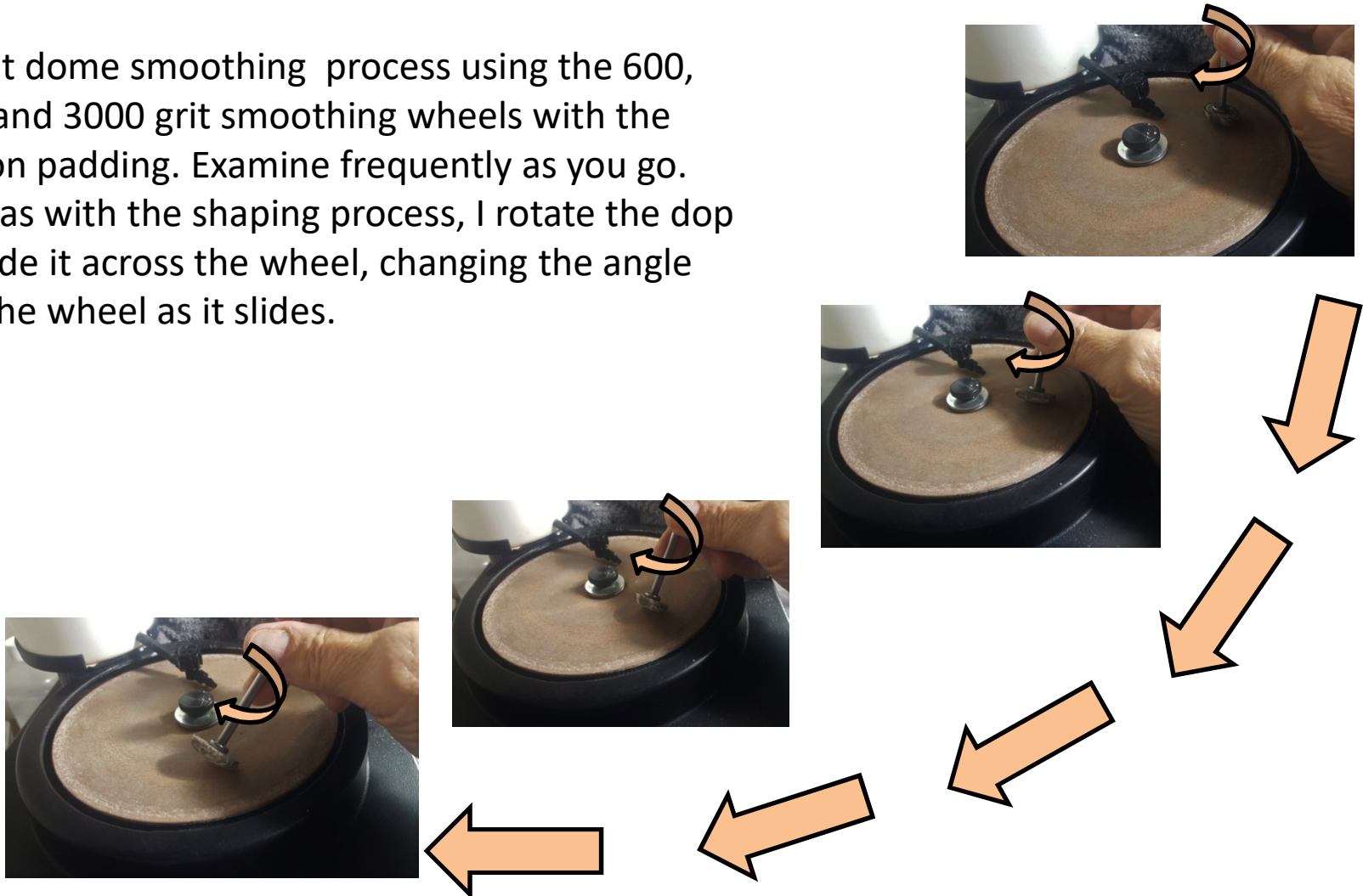


Do not recommend using the 325 grit smoothing wheel on the perimeter of the stone. Better to use the 600 and finer grit smoothing wheels.

Creating Cabs with a Flat Lap

Stages 2, 3 and 4 – Dome Smoothing

Repeat dome smoothing process using the 600, 1200 and 3000 grit smoothing wheels with the cushion padding. Examine frequently as you go. Same as with the shaping process, I rotate the dop as I slide it across the wheel, changing the angle with the wheel as it slides.



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Stages 2, 3 and 4 – Dome Smoothing (con't)



Check the progress of the shaping frequently. Still want to maintain the uniformly symmetric dome in both axes.



Recommend using only the 1200 and 3000 smoothing wheels on the perimeter of the stone. Want to minimize removal of any stone material which would negatively impact setting fit.

Creating Cabs with a Flat Lap

Cabochon Polishing

The polishing of cabochons varies greatly depending on the stone. I have found several web sites that specify the best buff surface/polishing compound combinations by stone. One is shown below.

Material	Hardness	Buff/Compound			
		Best	Better	Good	Ok
Agate	6.5-7	C1	D1	B3	
Amethyst	7	C1	D1	B3	
Beryl	7.5-8	C1	D4	D2	B3
Calcite	3	E5	D5		
Chlorastrolite	5-6	C1			
Feldspar	6-6.5	C1			
Garnet	7-7.5	C2	C1	B3	
Glass	5.5	C1			
Goldstone	5.5	C1			
Hematite	5.5-6.5	E1	A4		
Howlite	3.5	C5	D4		
Jadeite	6.5-7	D4	D2	E5	
Jasper	6.5-7	C1	D4		
Lapis Lazuli	5-6	D4	D2		
Malachite	3.5-4	D4	D2		
Nephrite-Jade	6-6.5	D4	D2	E5	
Obsidian	5-5.5	C1			
Opal-Australian	5.5-6.5	C1	E5		
Opal-Mexican	5.5-6.5	B3			
Psilomelane	5-6	D4	D5		
Petoskey Stone	2-6	A5			
Quartz	7	C1	D1	B3	
Rhodochrosite	4	D4	D5		
Rhodonite	5.5-6.5	D4	D1		
Serpentine	2.5	D4	D5		
Sodalite	5.5-6	C1			
Thomsonite	5-5.5	C1			
Tigers Eye	7	D4			
Tourmaline	7-7.5	D4	D2	A3	
Turquoise	5-6	D4	D5		
Unakite	6-7	C1			
Variscite	4-5	E4	D2	D5	

BUFFS

- A. **Canvas:** Canvas is useful when polishing heat-sensitive stones because it develops very little friction.
- B. **Phenolic:** Phenolic tools or phenolic lap disc (cab laps) are useful when impregnated with diamond grit. 14,000 Micron (pre-polish) or 50,000 Micron (polish) diamond compound can be applied to the surface of the gemstone and worked with a phenolic carving tool. It can also be applied to the surface of a phenolic lap disc and worked with the gemstone mounted at the end of a dop stick. The diamond will charge the phenolic plate making smoothing and polishing easier.
- C. **Felt:** Felt is useful for polishing glass and stones of even texture. It is not recommended for gemstones that under cut. Friction on felt generates heat rapidly.
- D. **Leather:** Leather is a versatile buffing material that is both efficient and economical. Leather generates heat, but not as much as felt.
- E. **Muslin:** Muslin buffs are recommended for soft stones and gems that are heat sensitive.

POLISHING COMPOUNDS

1. **Cerium Oxide:** Cerium oxide will polish at a faster rate than conventional polishing compounds and produce a superior optical lens surface with no staining or caking. Because it will polish faster, a lower concentration can be used. It is recommended for use on leather, felt, polyurethane foams, and thermoplastic polishing pads. It is a favored polish for quartz type minerals and other gemstone types. It is not recommended for gemstones that will under cut. Color: Buff/Tan
2. **Chromium Oxide:** Chromium oxide is a hard polishing agent. It is green in color and stains badly. It is useful for polishing jade and stones that will under cut. Color: Green
3. **Diamond:** Diamond grit is the most efficient polishing medium. It is especially useful for polishing difficult-to-polish stones. Color: Gray
4. **Linde "A":** A .3 micron aluminum oxide powder that is carefully graded for uniformity of grain size. It is excellent for polishing stones that will under cut. Excellent for hard to polish stones. VERY Expensive. Color: White
5. **Tin Oxide:** Tin oxide is an excellent general-purpose polish. It is used to provide a final high gloss finish. Color: White.

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Cabochon Polishing (con't)

This stone (gneiss) isn't shown on the chart, but it closely approximates agates and jaspers. Both of these show Felt/Cerium Oxide combo as best. I have read where aluminum oxide can be used instead of cerium oxide, so that's what I use. I made a thick paste of aluminum oxide and water and keep it in a sealed plastic container. I put the felt pad on my flat lap, spray water on wheel as it rotates, dip the stone in some water, then dip it into the aluminum oxide paste to cover the dome surface. Polish using same movement of the stone that is used for all the shaping and smoothing. Dip in water/oxide frequently to prevent stone from getting too hot. Repeat this until a satisfactory polish is achieved. I also have a wheel pre-charged with cerium oxide, and another wheel with mole skin surface (approximating a leather/canvas surface) that I also use with aluminum oxide. I use these wheels using the same procedure as described above with the felt wheel. I generally follow the chart on the previous slide for surface/compound combination used. However for this stone, I used another polishing method. I bought two polishing wheels, 8000 and 14000 grit (see Slide 4), and use it just like the other wheels. Seems to work very well, especially on harder stones, and sometimes totally eliminates the need to polish with the Cerium Oxide or any other polishing compound. The final results are shown on the next slide.

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Cabochon Polishing (con't)



Finished dome, but, we are not done yet.

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Cabochon Mounting

Need to work the bottom (“B” side) of stone. This depends on the stone and the setting. My recommendations follow:

1. Opaque stone (like this one): Usually mount in a closed back setting and glued in place. Best not to polish the “B” side much. Glue sticks better if the surface is slightly rough.
2. Transparent or translucent stone: Usually mount in an open back setting so light can enter and help show off stone. The stone is secured in the setting by bending the top of the “wall” over the cabochon. Recommend a slight polish on the “B” side to better allow the light to work its magic.



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Completed Cabochon

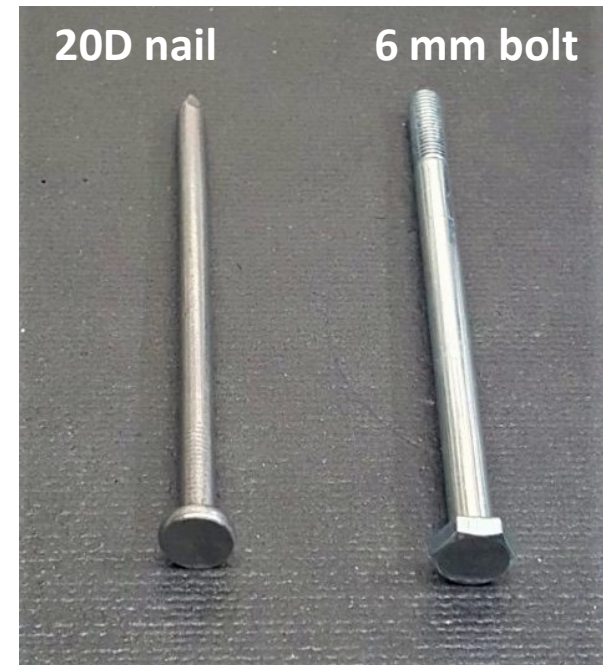


Totally finished cabochon. I soaked the cab in acetone to release dop stick, and finished the “B” side just a little per the previous slide.

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Update

I have recently changed what I use for dop sticks. I started out using 20D x 4" nails, and sized the holes in my fixture to fit them. This is the dop stick shown in this presentation. I did that because the nail head was reasonably close to being perpendicular to the shank. That ensured the angular relationships when I used my fixture. Now, I am using 6 mm x 100 mm bolts, and have made another fixture just like the first one, except the holes are now sized for the 6 mm shank of the bolts. The head is still reasonably perpendicular to the shank, so my angular relationships with my new fixture are still realized. But, I now have the added capability of using the same dop stick with my Faceting mast. The nails I was using were just a bit too small in diameter for the mast. It was made to accept a 6 mm dop. Since the bolts usually have the size stamped on the top of the head, I do grind them smooth before using. I use the 90° hole in my new fixture and the 160 grit shaping wheel to do this step.



Creating Cabs with a Flat Lap

The End

I hope you get some benefit from this presentation if you choose to use a flat lap.

Happy Grinding!!!

