

ATM Journal 5: Polishing Your Mirror

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By this stage we have a mirror that is of the correct focal length (more or less!) and should be ground with a very fine grit (9 micron or 2500) to remove every last pit left by larger grades of grit. Some people continue with 5 micron grit but I've discovered this is difficult to do and not run into problems with scratches, although fellow local RASC Winnipeg ATM Darren Townsley recently gave me a clue as to why this might be happening – when you grind your mirror, take care also to touch up your bevel with the same grade of grit you're using. Otherwise the bevel can potentially leak larger slivers of glass into your fine grit and cause scratches. I'll try this out with my next mirror (a 9" plate glass mirror currently on the stand going well in 240 grit – alas, summer and my observatory project has delayed this one severely!)

In any case, once you have fine ground your mirror, the next stage is to polish it into a real mirror. To do this, we put aside our tile tool and retrieve the un-tiled tool which you made at the same time, hopefully! If not, go cast another tool identical to the tile tool, sans tiles. It's probably best to do this before you get to polishing because the risk of scratching your mirror is pretty high when casting a tool. Note that in the "bad old days" one would have simply used the grinding tool for polishing, build a pitch lap right on top of the grinding tool – this is not good practice. The main reason for casting a second tool is to ensure that if the worst happens and you need to go back and grind out a scratch, you don't need to compound the problem by destroying your pitch lap as well!

A pitch lap is composed of pitch which is poured into the tool and faceted. At one time one was advised to pour the pitch into moulds and cut it with a knife into squares, but the advent of pitch moulds has made it possible to create an acceptable pitch lap by simply pouring the pitch onto the surface of the mirror and using the mould to create the facets. We'll examine this process in detail.

Pitch must first be melted to be pourable – you'll need a clean pot or coffee can, and a hot plate or burner of some kind. While some find the smell of melted pitch pleasant, domestic tranquility normally demands that melting pitch occur somewhere other than the kitchen stove! Personally, I bought a cheap hot plate and pot at Canadian Tire and dedicated them to pitch processing.

With the appropriate tools at hand, melt an appropriate amount of pitch to cover the surface of your mirror to approximate 15mm. Only keep the pitch on the burner long enough to melt it, as boiling will boil off important volatile liquids that will cause the pitch lap to be too hard. If this does occur, you can add turpentine to soften the pitch. The pitch is just right if you can cause a depression using your thumbnail pressed into the pitch for 10 seconds. Try your pitch before you melt it to see if it's hard enough. Obviously, this is at room temperature, hotter will make your pitch softer (and potentially require a harder initial pitch) while colder will produce a harder lap. A lap which is too hard or soft will produce inferior results.

To pour your pitch lap, place your tool on the stand face up and put a dam around your tool (see photo) to contain the pitch while it's liquid.

Next, melt your pitch and pour it onto the face of the tool, quickly so that it doesn't cool enough to get viscous. Let the pitch cool enough to allow removal of the dam, then place a mould on the face of the lap. The mould should be well smeared with a mixture of CeO (Cerium Oxide or some other polishing compound such as rouge) and dish washing detergent so as to allow you to release your mould. Using your mirror (also well smeared with CeO mixture), press the mould into the lap. It's very important that the squares be offset from the centre of the mirror so that you don't get a facet or a groove dead centre.



One way to increase your polishing efficiency for your lap is to "microfacet" the lap. I do this by lifting my mirror off the lap after pressing the mould down



into it, and placing a square of mesh from a bag of onions, and replacing the mirror. Leave both the mould and the mesh in place, and do a warm pressing of the lap – in other words, add some weight and let the lap conform to the shape of the mirror as it cools. I usually place a bucket of water on top of the mirror to press the lap into shape. The image below clearly shows the microfaceting prior to release of the lap mould.

Once your lap has cooled, you can carefully remove your mirror, pull off the mesh, and carefully remove the lap mould. You can use a knife to chip away the excess pitch from the lap to save for your next lap. The result should be a well-formed lap, ready to polish!

Polishing may use the same 1/3rd COC stroke as grinding, or you may choose to polish with a slight W motion, no more than 1/3rd the width of the mirror. I've found that a slight W stroke produces a perfect spherical polished surface, which is the aim of the polishing operation. Using a slurry of CeO mixed with dishwashing liquid in a squirt bottle provides an easy way to refresh your polishing agent. Generally one need not sponge off the mirror or tool, but simply squirt more slurry onto the mirror and continue polishing. Polishing may be done MOT or TOT. I generally find that MOT is slightly more efficient at polishing the edges of the mirror, which tends to be the last area on the mirror to be polished. Polishing can tend to be hard work, and should be done at a relatively easy pace of 60 double strokes per minute. If you notice some resistance in the strokes this is a sure sign that polishing is taking place, but be careful not to let your mixture dry too much or you might find the mirror and the tool stick together. If this should occur, back off the tool in the same direction you were stroking and it should come off. If they are stuck together well, immersion in a bucket should separate them, or place them in the freezer to let the differing coefficients of expansion force them apart. Needless to say, never attempt to pry them apart or you will scratch your mirror!





Polishing can take a significant amount of time. An 8 inch mirror can take 10-12 hours until the edge is completely polished out. The more time spent the better, as you can't polish a mirror too much, and discovering your mirror is still "grey" after coating is disappointing to say the least. Upon completion of polishing, you should end up with a spherical mirror – test this by trying the blinds test as above. If the reflection of vertical blinds show up straight, you've done well. Next, building a Foucault Tester and figuring your mirror! As homework, check out:

http://www.stellafane.com/atm/atm_foucault_tester/atm_tester_main.htm

DON'T HAVE ONE? BORROW ONE!

The Winnipeg RASC owns a number of telescopes which are available for loan.

They consist of:

- ▶ a 75mm f16 polarex(unitron) refractor with an alt/az tripod
- ▶ a 4.5"f8 newtonian on a dobsonian mount
- ▶ a 6" f8 criterion on an equatorial mount
- ▶ a 8"f6 newtonian on a dobsonian mount
- ▶ a Celestron C8 8"f10 schmidt cassegrain with equatorial wedge/tripod.

All of these telescopes come with eyepieces and finder scopes. They are available on a first come-first served basis, and can be booked for 1 month at a time.

The Celestron requires a 1 year WPG RASC membership to book. The telescopes can be had by calling Ray Andrejowich at 667-6896, and can be picked up at his house or at the astronomy club meetings. Picking up and dropping off at the astronomy club meetings is the preferred method of acquiring, but alternative arrangements can be made with Ray.

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