What grit/micron should I have mirror polish?

Posted by t76turbo - 16 Nov 2011 21:01

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Here is my lineup of available paddles....

100/200, 400/600, 800/1000, 1200/1600 ceramics, 3.5/5 micron paste on leather strops, and 3.5/5 micron paste on balsa strops.

I also have 1 and .25 micron sprays but I need to get another leather strop set to use it on.

I have done a few knives since getting the WEPS. I have gotten some pretty good results edge wise. But I just can't get the perfect mirror. I always have some residual hazing no matter how long I stay at each step or how I vary the direction. If I had a better macro lense I would take a pic but I dont. Just suffice to say the mirror is impressive to most folks but I know I can do better.

So how low do I need to go to get a perfect mirror finish? Or do I need to maybe work longer at some of the later steps? I thought I did enough but maybe not.

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Re: What grit/micron should I have mirror polish?

Posted by PhilipPasteur - 30 Jul 2012 19:44

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Couldn't resist... for post # 100.

I added a bunch to the post I made just before Mark's

4254.

I hope I wasn't too wordy.. I hate typing

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Re: What grit/micron should I have mirror polish?

Posted by PhilipPasteur - 30 Jul 2012 19:45

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#4254.

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Re: What grit/micron should I have mirror polish?

Posted by AnthonyYan - 30 Jul 2012 22:10

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The wavelength of visible light is between 0.38 and 0.74 microns.

en.wikipedia.org/wiki/Visible_light

Modern optical microscopes have a resolution limit of 0.2 microns (about 1/2 wavelength).

microscopyu.com/articles/optics/index.html

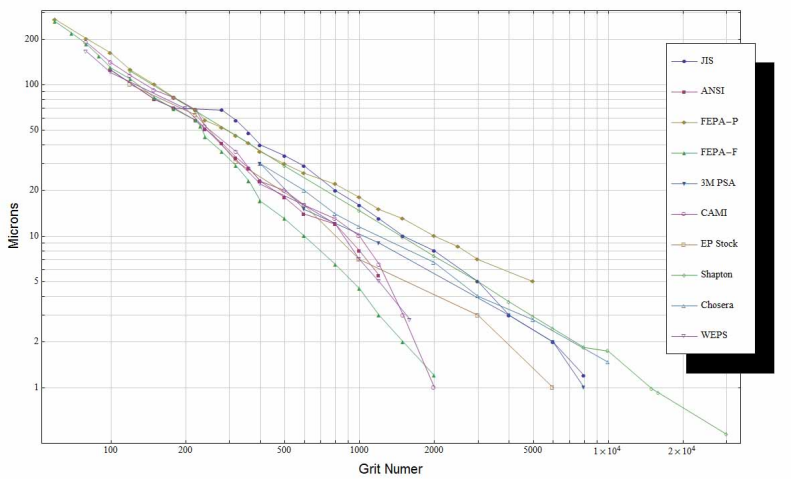
Telescope mirrors are accurate from about 1/8th to 1/20th wavelength, with the most common being around 1/10th wavelength. Although, they are often smoother than this.

So if you can get your scratches significantly below 0.2 microns then you should have a very good mirror finish. So my guess is if you can get scratches down to around 0.1 to 0.05 microns, it'll be a superb mirror finish even under a microscope.

It is interesting to think about the above in relation to the size of abrasive particles. Although I have no idea how to go from particle-size to scratch-size (it's too complicated; depends on hardness, shape, friability, pressure, binder, etc.).

Komitadjie's Grand Unified Grit Chart as plotted by Mr. Wizard:

www.knifeforums.com/forums/showtopic.php?tid/904090/tp/7/



Slagerly
Lagrangian

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Re: What grit/micron should I have mirror polish?

Posted by PhilipPasteur - 30 Jul 2012 23:40

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Anthony,

Godd stuff.. in theory. Unfortunately you do not take into account the intrinsic reflectivity maximums for a given material. I will send some info tomorrow form one of the premier polishing companies in the world claiming a max of 65% reflectivity for "stainless steel". Of course different limits for different formulations of steel.

In any case, folks using 1000 grit diamonds will not see a mirror finish. People percieving a "mirror" at the 1200/1600 grit level, have a reflective surface, but a ways to go to get to the reflectivity limits of steel. My post was because I was trying to explore how some people say they have a mirror at X grit and others at XXX grit, and what accounts for the difference.

According to Tom and he has photomicrographs at 400x, the 0.17 micron grit of the 10K chosera is where he saw significant reflectivity ... at 400X that is as good as the empirical data that I have seen goes.

I will be intersted to see what can be done with Clays new microscope. I would love to see some sort of hard data that sorts one person's mirror from another's more highly polished mirror.

This is real interesting stuff.. as soon as we figure out that we can polish metal to the degree that we can rival optical mirrors... I can throw away a bunch of pyrex mirrors ground to 1/20 wave and optically coated for 96 to 98% reflectivity...

(of course then you have to deal with coefficients of expansion and other obtuse issues. They did give

up on speculum polished metal mirros a hundred years ago...

Of course, then we need to figure out who cares about reflectivity of an edge... sharp is what we want.. polish is just pretty...

Phil

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Re: What grit/micron should I have mirror polish?
Posted by wickededge - 31 Jul 2012 08:26

This is the best I've been able to do so far and I've been able to repeat it several times: Polished Edge I haven't had a chance to do it again and put it under the new scope (plus I'm still waiting for the 100x objective to come back from the manufacturer) but I'm pretty excited to check it out once I get back from VT.

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Re: What grit/micron should I have mirror polish?
Posted by wickededge - 31 Jul 2012 10:26

I was able to do some measurements at 800x of a knife I sharpened up to the 10k Chosera stones. Check here for the full sized image: 10K Chosera - 800x

For some reason, the measurements are really hard to read there, but they range from .89um to 1.51um. I only measured the major scratches. I'll keep working on how to post the images so that the measurements are easy to read.

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Re: What grit/micron should I have mirror polish?
Posted by cbwx34 - 31 Jul 2012 10:33

RonRobichaux wrote:

I just purchased the WES a few weeks ago and have the same problem with getting a mirror look.

The smallest grit stones I have are the 800/1000 then the 5 and 3.5 strops.

How do you know when to go to the next highest grit. because my edge is not even close to mirror.

now it is sharp but dull and scratchy looking. I spent 30mins working on this.

Should the 1000 grit leave a smooth not polished finished...???

Is there a step by step instruction

on going from one grit to another?

[attachment:3]spdy blade.jpg[/attachment]

To add a bit to this... I sharpened a knife and repeated what you have... 1000 --> 5m --> 3.5m leather, and couldn't get a mirror finish, even with quite a bit of time on the leather. So, probably not possible, at least not in a reasonable time. (Forgot to snap a photo).

I then went back to the 1000 and then went to the new MicroFine ceramic... coarse then fine for about 50 passes with each. (I haven't lapped my stones). Then on to the 5m --> 3.5m leather for about 75 passes each, and got the start of a mirror finish (obviously without magnification)...

Still a bit of scratching, but considering how little time I spent, this would be at least a good start toward a finer/mirror finish, if that's what you're looking for.

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Re: What grit/micron should I have mirror polish?

Posted by PhilipPasteur - 04 Aug 2012 21:13

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I suppose that I am beating a real dead horse here, but

Shouldn't we have some kind of definition of "mirror edge"

before we try tell people how to get one?

I just finished a Ken Onion Foresite, suposedly an initial production blade in (depending where you read) Acuto 440 or Acuto +.

I went through the diamonds form 100 grit. I reprofiled to 18 degrees, just to see how this steel would do.

After the 1000 diamonds the blade was plenty sharp, but pretty much a matte finish.

I sued the Chosera 800 grit for 100 strokes, still matte finish. I went to the 1000 grit Chosera stones for 100 strokes. Now I was getting something that was pretty reflective, but still not what I call a mirror edge.

I progressed through the 2K and 3K Chosera stones, now I could see detail in the reflection form the blade. At this point I would call it real darn shiny, but not a mirror. I think at this point well taken photos on a macro level would show clear text reflected.

I went to the 5K Chosera stones for 150 strokes. Now it was real shiny. Good enough given the angle of the reflection to make real impressive pictures with text reflecting off of the edge. Still if a light was shined pretty close to along the edge and the eye close to parallel to the blade, there was a bit of fog.

I went to the 10K choseras fro 150 strokes. Now we are getting close to a mirror. It is gleaming with incident light, but at at angle close to 180 degrees, still a bit foggy.

I went to a Naniwa 12K Superstone for 150 strokes. Now it is getting close to your bathroom mirror. The overhead light quite detailed in the edge, without picking the best angle.

I have a 15K Shapton set still to try, but I skipped that and went to strops with 6 micron, 3 micron (DMT paste) and then 1 micron and 0.5 micron diamond on leather. I don't think that this changed the reflectivity much at all. I only did 100 strokes per grit. Just enough to refine the edge a bit and give a bit of convex grind to it. The knife is really scary sharp and glitters like freshly polished chrome.

So what is a mirror edge? Obviously to me, that is relative to the observer, the kind of steel and how much the edge is polished. The constant in the conversation is, finer grits make for a more

polished/reflective edge. The more reflective the edge is, the more mirror like it is.

If you aren't getting what you consider to be a mirror edge, use finer grits !!

As a direct answer to the OP, for my definition of a mirror edge, you need to get to the 5K Chosera level (or Shaptons, but according to Tom, who loves the Shaptons, they don't polish as well). That is about 2.8 microns (2.94 for the Shaptons). You can definitely get there with pastes or 3M lapping films at the similar grit levels, but it will take much longer. There is just not as much abrasive involved in the pastes, sprays or films as the better stones.

Phil

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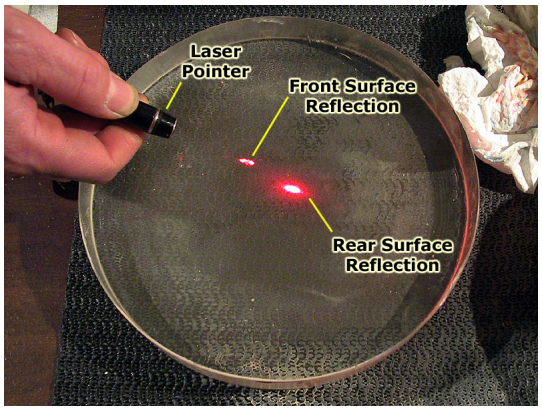
Re: What grit/micron should I have mirror polish?

Posted by AnthonyYan - 05 Aug 2012 00:03

I like to use the optics standard for mirror finish, which means that a surface is smooth enough to do high quality imaging, such as for a camera, telescope, or microscope.

Amateur telescope makers grind their own mirrors, and to test the quality of their polished mirrors, they use a laser-pointer test.

stellafane.org/tm/atm/polish/polish.html#Polished_Out



If the mirror is sufficiently polished, then all the reflected light obeys angle-of-incidence is equal to angle-of-reflection. (A fraction of the light is adsorbed of course, but that is irrelevant to our discussion.) This means that you should not be able to see any laser spot at all. This is because _all_ of the laser

light reflects away from your eye (or camera), which means, you can't see it!

Unless of course, you are looking at it from the angle-of-reflection, in which case you are damaging your eye (or camera) with direct laser light.

In the picture above, the mirror is not polished out because you can see the front-surface reflection. This means that some light is scattering off in "random" directions from tiny residual scratches. Because light is scattered "randomly" by residual scratches, some of it is scattered into the camera, which is why we see it in the photo.

Once your scratches start going below half of an optical wavelength, you will be at or close to an optically smooth finish (ie: mirror surface). Loosely speaking, light cannot notice features which are much smaller than its wavelength. This is why astronomical telescopes are typically accurate to 1/10th wavelength. More accurate mirrors exist, but that is at the point of diminishing returns in terms of image quality. For astronomy a mirror that is accurate to 1/4th wavelength is considered to be the lowest quality that is still (somewhat) usable.

The optical standard(s) of mirror-finish are very high. Someday, I would like to attempt an optical quality mirror-finish on a knife edge for no reason other than my own amusement.

In practice, being able to read fine-print text in the reflection of your knife bevel is, in my opinion, a good enough definition of mirror-finish. Say, your eye 6 inches away from the knife and the text 6 inches away from the knife. One might also require that the surface have no noticeable "haze".

By the way, please remember:

(1) Do NOT look at a laser directly!

(2) Do NOT look at a directly reflected laser from a shiny surface. For example: windows, polished metal, etc.

(3) Do NOT look at laser light through any optics. Optical lenses and mirrors can focus laser light to the point where it will cause eye damage.

Doing any of the above can cause eye and/or camera damage. Even if the laser is a low-powered laser-pointer.

Sincerely,

--Lagrangian

P.S. The adsorbed light is not really relevant for our discussion in the following sense: Black obsidian (basically black glass) adsorbs a very large fraction of incident light (that's why it is black). But black obsidian has been used as mirrors in ancient times because it can be polished to a shiny flat surface. Flat and shiny enough, that you can clearly see yourself in the reflection.

en.wikipedia.org/wiki/Mirror#History

Just as black glass can have a reflection, even materials with relatively high adsorption can be polished to a mirror finish. Steel is more than reflective enough to make a mirror. For example, many high-precision steel ball bearings have a mirror finish. Here is a company that does optical-polishing of steel to create steel mirrors and optics:

www.precision-metal-optics.com/stainless-steel-mirrors.htm

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Re: What grit/micron should I have mirror polish?

Posted by PhilipPasteur - 05 Aug 2012 17:10

AnthonyYan wrote:

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"Visible light is approximately in the range of 0.4 to 0.7 microns (okay, if you are really picky, the 0.38 to 0.74 microns). If you want, that's 400 to 700 nanometers, or 4000 to 7000 angstroms."

Is a quote that is helpful from one of Anthony's previous posts.

If we go with the half wavelength figure as indicating optical mirror quality we would have to polish to about 0.025 microns to get to this optical quality level. This assumes that the depth of the scratches we get are equal to the grit size, which is not always the case. Of course there is the additional polishing as the grit on the stones fractures and becomes smaller. We may get there with 0.1 micron abrasives as they break down... and with more time.

This site has an interesting chart:

www.warleypolishing.co.uk/technical/surf...nish-table-guide.php

They have two grades at the high end. Both claim a surface roughness figure of 0.5 microns. The difference is in the amount of reflectivity. It would seem from this that there is more to polishing than surface finish alone. There is the part that I call brightness. Maybe I can see a reflection enough to see print at 3 micron grit, but it is much brighter and better refined at 0.5 microns.

I like the 6 inches to the subject and 6 inches to the eye definition, because at least it is some kind of definition. Maybe we could refine it and state the font size that represents "fine-print". Perhaps a number 4 point font? The one thing that is not there, and without sophisticated measuring equipment, is very subjective, is brightness of the image. I am not sure how we cover that one.

One thing for sure though, we never can get an optical quality mirror surface on our edges. The max reflectivity of typical stainless steels is about 65%. This does not come close to the 90%+ (some as high as 99.9% in dielectrically coated flat mirrors as in the case of a couple of the star diagonals that I use)in an optical mirror.

Phil

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