Foucault Tester

To test the optics that a mirror maker is creating, the best tool is a Foucault tester. This can easily be made by anyone with a minimum of tools: a saw, a drill, hammer and screwdriver and a soldering iron.

First of all, I should mention this design should not be copied slavishly. It is a workable tester and is quite easy to build. But there is quite a bit of latitude in design. Feel free to think of ways to improve it. And go ahead and ask questions. For example, because I planned to use a videocamera with mine, the part which holds the knife edge and light is at the front of the tester. This makes getting the eye in the proper spot a little more difficult. If you only intend to do visual testing, placing it near the back would make it easier to use.

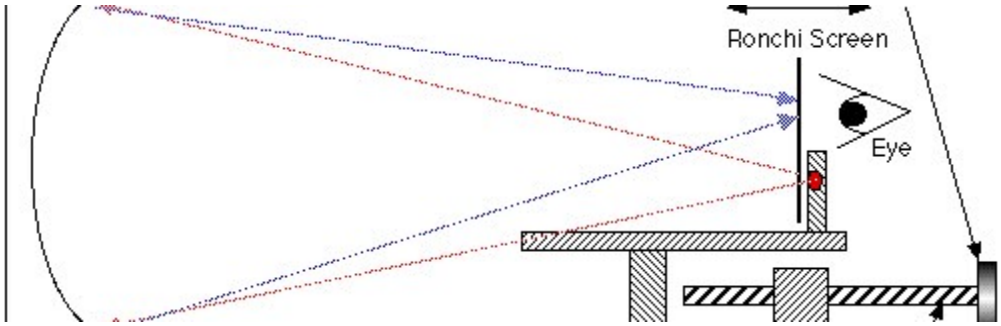
This page is under construction, as is the tester. It is now being set up to handle a VCR camera easily. Here are some images of mirrors at various figuring stages. They should help you know what to expect to see when using a tester.

Parts:

- Maglight (tm) light bulb from their small penlights. Or you can purchase the replacement bulbs at most hardware stores. Some people have also used bright LEDs with good success instead of the Maglights.
- D cell battery, and a D cell holder. If you use LED's, you will need two, in series, to provide 3 volts. I sometimes use the Maglights with 3 volts to get more light and contrast.
- Optional switch to the batteries.
- 1 Single sided Razor Blade and/or Ronchi screen
- Scotch Tape (the frosted kind)
- A few wood screws
- Optional sheet metal cover
- 1/4" diameter threaded rod about 5 inches long, 20 threads per inch (transverse rod)
- 1/4" rod about 2.5 inches long (to move blade into light reflected from the mirror)
- Rubber band (or spring, to keep platform)
- Scrap plastic about 1" by 2" for V blocks (wood could probably be used here also)
- Wood boards. 3/8 to 3/4" Plywood works well, but it is not critical. Also 1" board can be used. Scrap lumber will work fine. The important thing is that it be flat and free from warpage. This will be cut into 3 pieces:
  - 1 Block of wood, about 2-3" wide by 5" long for the eyepiece section
  - 2 Blocks of wood 4" wide by 6" long (exact size not critical). One becomes the base, the other is the glider that sits above the base.
  - It does not do harm to make everything larger- especially for the base as it can actually help add some stability due to added weight.

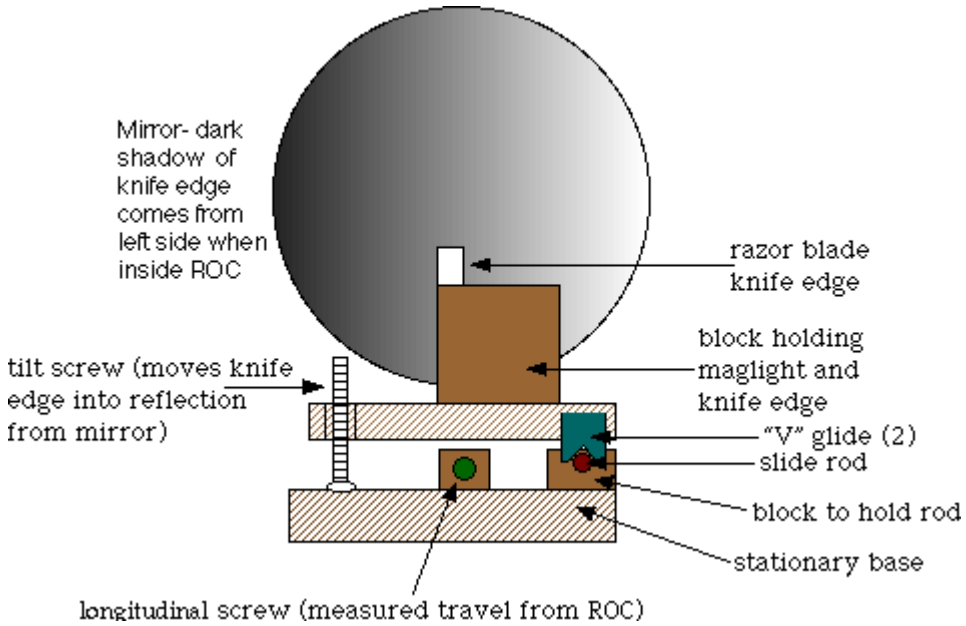
Basics of the Tester

Before I go into the Construction and photos, here is the basics on how the test is used. I have found that the Ronchi test is easiest for beginners, so this will assume you have a ronchi screen in the tester. At the exact Radius of Curvature of the mirror (ROC), which is exactly twice the focal length, the Ronchi test actually becomes the Foucault test. Much figuring can be done using the Ronchi lines and then Foucalt measuring, which is more difficult and time consuming, can be left for when the Ronchi indicates an acceptable mirror.

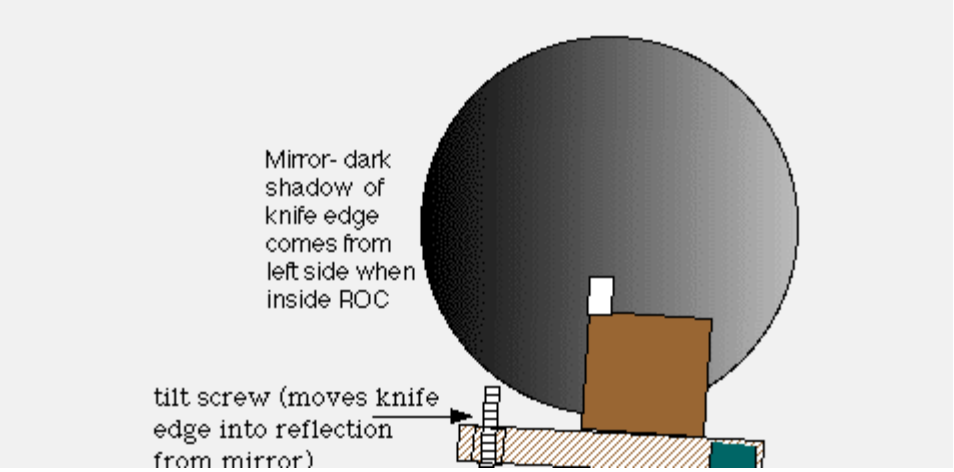


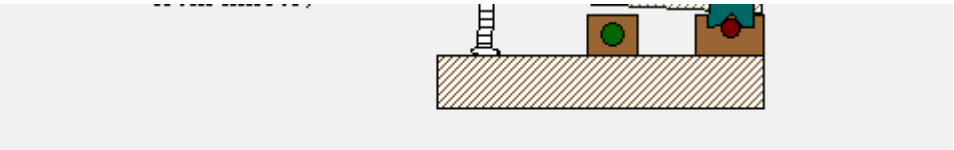
The mirror is on the left. Light leaves the bulb travels to the mirror and is reflected back to the observer who sits at the tester. It is important to have the tester on a solid table, as measurements for Foucault require accuracy to at least .002". Amazingly enough, get such accuracy is not too difficult to do even with common screws!

Here is a schematic view of the tester as seen from the eye position, looking towards the mirror, explaining the parts of the tester.



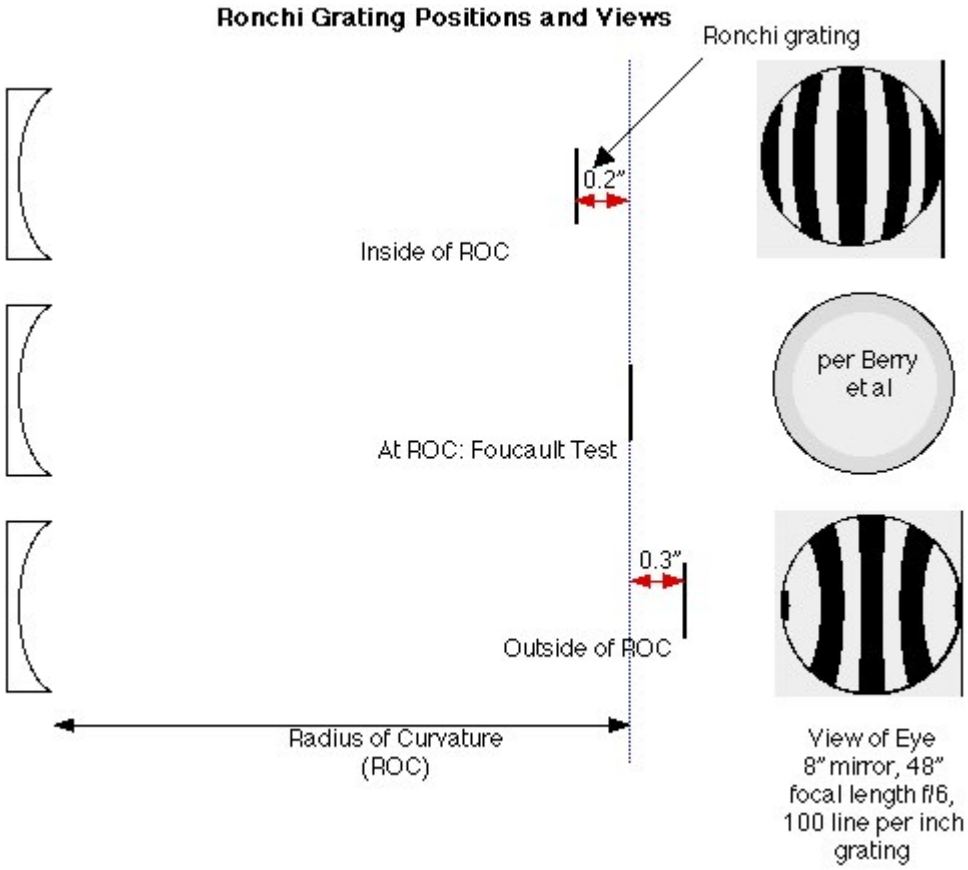
To perform the Foucault test or to adjust the Ronchi bands to appear where desired, the tilt screw is used to tip the entire top portion of the platform, as seen below:





This is an exaggerated view. Notice how the shadow has moved across the mirror, from the left. If your mirror is completely illuminated, without shadow, you may need to slide the entire base over until it is close enough so that the blade can be tilted into the narrow light cone.

There are two basic functions that the tester must perform. The knife edge must be able to move longitudinally (or axially) towards or way from the mirror. That is, along the path that the light takes. You will generally use the grating or knife edge just inside the Radius of Curvature (ROC, which is 2x the flocal length of the mirror).This distance must be measured acurately, typically to a few thousanths of an inch with the Foucault test. Secondly, the knife edge must be able to tip into the returning cone of light from the mirror (transversely). This motion is not measured, but is used to slowly gray out portions of the mirror.



The drawings of the Ronchi lines as seen above is actually from my Ronchi testing program. Additional help on theuse of the tester can also be found there.

Construction Photos:

Here is the top part, before being put together. You can see the bulb is on, just to help it show up more. The metal cap piece just helps keep stray light down, it really isn't necessary, but helps the completed unit look

much better. It was made from thin sheet metal (aluminum) I found at Orchard Supply for about $0.50. You can get a feel for the dimensions from the size of the batteries (D cells)

Here's the pieces about to be assembled. The light is layed in a channel I cut in the wood with a utility knife. You could also drill it (actually I drilled first, then enlarged it with the knife. Wires are just soldered onto the bulb. Lacking a soldering iron, I suppose you could try superglue, just try to keep some bare wire touching the bulb without glue. Note the 1/8" hole drilled in the aluminum cap (cover). This is placed directly over the bulb seen behind it on the wood.

Below is the assembled "guts" of the tester. Two razor blades have been taped with a few sheets of paper thickness separating them. They lie directly in front of the filament, that is, over the 1/8" hole drilled in the sheet metal. Before adding them, I put two pieces of cellophane tape over the bulb to soften the glow of the bulb. This is a slit configuration of the Foucault test.

The Slitless Tester

Some prefer a slit tester as above. I now recommend and most often test using a **slitless** modification of the

above tester**.** The Slitless is identical except that only 1 razor blade is used. By eliminating one blade, more light gets through and the problem of keeping the blades parallel goes away. Remove the short blade, keeping the one that sticks over top the eyepiece unit.

The rest of the tester