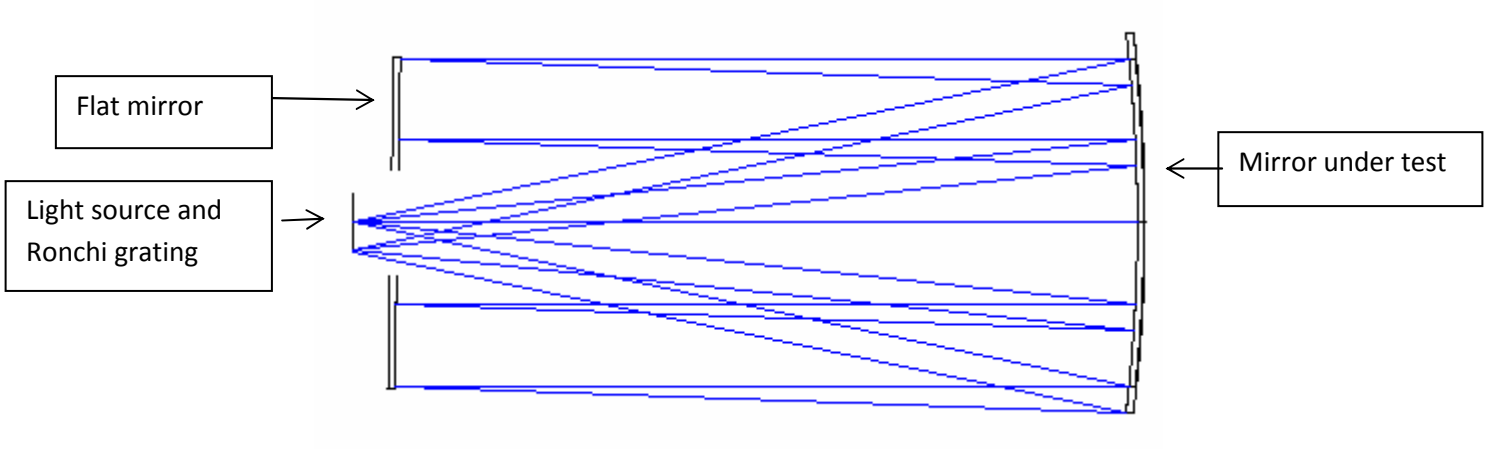
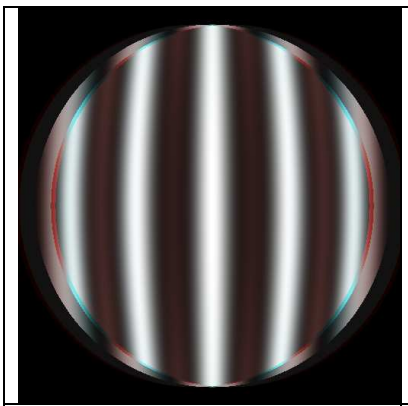
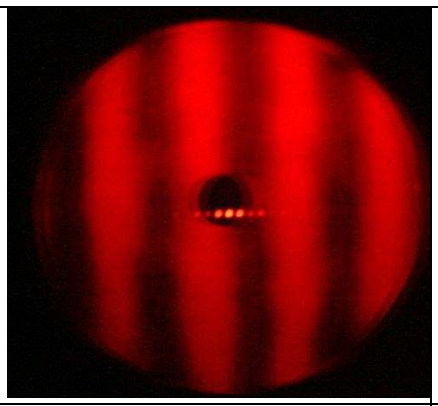
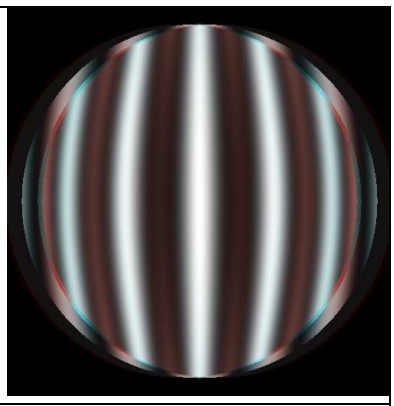
How do we know how good a telescope mirror is?

The method used by Nichol Optical to test parabolic telescope mirrors is the double pass null test, also known as the autocollimation test. The test setup is shown below. The mirror under test is setup facing a perforated optically flat mirror. The separation is a little less than the focal length of the mirror, the spacing is not critical. The light source is placed behind the perforation in the flat mirror. Light reflects off the mirror under test and hits the flat mirror, it is reflected back to the mirror under test and then back through the hole in the flat mirror to form an image next to the light source. The fact that the light is reflected twice by the mirror under test makes this test very sensitive.



A perfect parabolic mirror shows straight Ronchi bands with this test. A less than perfect mirror shows bending of the Ronchi bands. Computer software is used to predict the appearance of the Ronchi bands for any mirror of known diameter and focal length.

The following example is for a mirror of diameter 405mm and focal length 1814mm, F =4.47.Ronchi grating = 10 lines/mm

		
1/8 pvwavefront error RMS (wavefront) 20.5nm Strehl0.95	Mirror under test	1/4pvwavefront error RMS (wavefront) 41nm Strehl0.82

The image of the mirror under test has not been processed other than having its brightness increased. Some irregularities on the mirror's surface are the result of air currents in the test area. Based upon the computer generated images it can be seen that the test mirror meets the 1/8 pv wavefront error standard.

Clearly, this test method does not produce a set of numerical values describing the mirrors surface, and for this reason Nichol Optical does not provide a numerical analysis of mirrors for customers. A statement of quality is supplied with all telescope mirrors outlining the test method and the optical quality based upon the method described above.

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