

COR-1A/B Plate Scale Verification

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March 24, 2005

The various reports to date on the COR-1A and COR-1B instruments have used the nominal plate scale of 3.75 arcsec/pixel in the analysis. This report is intended to demonstrate that the instrument plate scale matches the nominal plate scale.

The plate scale can be derived from Air Force 1951 Resolution Test Target images, such as the example shown in Figure 1. Each group of bars has a group number N_g , and an element number N_e within that group. For example, the large set of bars in the lower right corner of Figure 1 have a group number of $N_g = 2$, and an element number of $N_e = 1$. The rest of group 2 is along the left side. The width of the bars, in millimeters, can be derived from the equation

$$W = 2^{-(N_g+1+(N_e-1)/6)} \quad (1)$$

From this, one can calculate that the large bars of set (2,1) in the lower right corner each have a width of $W = 2^{-3} = 0.125$ mm. The spaces between the bars have the same width, so that the total distance between the outer edges of the set of the three bars is $5W = 0.625$ mm. Each set of three bars makes a perfect square, so each bar is also 0.625 mm long.

To translate this into arc seconds, one needs to know how the target was projected onto the instrument. During vacuum testing at NRL, this was done with a single-lens collimator with a focal length of $f = 1250$ mm. From f , one derives a plate scale of $s = 648000/(f\pi) = 165.012$ arcsec/mm. Therefore, a distance of 0.625 mm translates into an angular distance of 103.1 arcsec. With the nominal plate scale of 3.75 arcsec/pixel, one should measure a size of 27.502 pixels. The actual measured sizes for COR-1A and COR-1B are shown in Table 1, along with the inferred plate scales. The measurements are very close to the nominal design value of 3.75 arcsec/pixel, and are within the requirement of < 3.85 arcsec/pixel.

Table 1: Measured sizes of group (2,1) in Air Force Target images, and the resulting instrument plate scales.

Instrument	Size (pixels)	Plate scale (arcsec/pixel)
COR-1A	27.36 ± 0.13	3.769 ± 0.017
COR-1B	27.26 ± 0.06	3.783 ± 0.008

Similar measurements were made in air with a Meade telescope as collimator, with a plate scale of 179.7 arcsec/mm. The results are essentially the same. However, some adjustments to the Meade focus needed to be made to take into account the difference in the instrument performance in air versus in vacuum, so the vacuum chamber results are to be preferred.

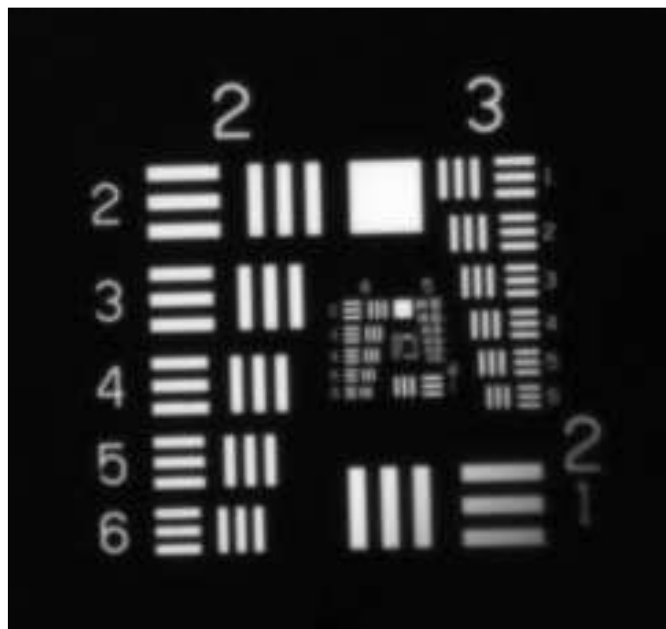


Figure 1: Sample image of Air Force 1951 resolution test target. This image has been rotated by 90° and reflected to make the lettering more readable.