

## Q: What is the limiting resolution of a lens?

### A:

The nature of light sets a fundamental limit on the maximum resolving power of any lens. This limitation is set by the laws of physics, and has nothing to do with how precisely the lens is fabricated<sup>1</sup>.

### Upper limit on resolution

$$F_{\text{cutoff}} = \frac{1}{F_{\text{number}} \cdot \text{Wavelength}}$$

**Numerical example:**

Fnumber = 4.0

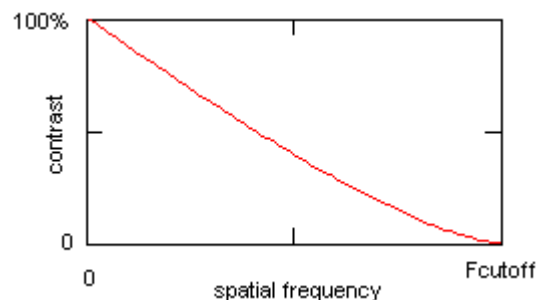
Wavelength = 0.5 microns

F<sub>cutoff</sub> = 500 cycles per mm

The sample lens is incapable resolving any frequency components above 500 cycles per mm.

### Limit on contrast at lower spatial frequencies

There is also a theoretical limit<sup>2</sup> to contrast at lower frequencies:

**Numerical example:**

Let's continue to use the same sample lens.

The maximum contrast the sample lens can achieve at 250 cycles per mm is about 39%

<sup>1</sup> This formula sets an upper limit on the resolution of a lens. A poorly fabricated lens may fall far short of this limit.

<sup>2</sup> See, for example, *OSA Optics Handbook*, Volume 1, pg. 32.4.