Know your Telescope….summary

By Richard Parker 2004

1) Radian measure

   57.25 degrees per radian (one radian is one radius laid on the circumference of a circle.

2) 206,265 arc sec per radian

3) Image scale

   $\theta/h = 206{,}265/f$

   where h and f are mm then scale is arcsec per mm at the focal plane

4) Magnification

   M = F/f or D/d

   where F = focal length of primary, f = focal length of eyepiece, D = diameter of aperture, d = diameter of exit pupil.

5) Minimum magnification set where exit pupil fits into 7 mm eye pupil at night

   M = 0.13 * D where D is mm

   M = 3.3 * D where D is inches

5) Eyepiece for minimum magnification

   f ' = 7.7 * focal ratio where f ' is desired in mm

   f ' = 0.3 * focal ratio where f ' is desired in inches (rarely the case)

6) Maximum magnification (somewhat subjective)

   Mr' = 30 * D where it is assumed exit pupil small limit is 0.85 mm or 1/30 inch. Most realistic. USE THIS ONE

   Mr' = 13 * D where F is inches and assumes your eye can resolve 1 min arc

   Mr' = 24 * D or 36 * D where your eye can resolve 2 or 3 min arc. More realistic

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7) Eyepiece for max magnification

f' = 0.90 * focal ratio where f' is desired in mm

f' = 0.033 * focal ratio where f' is desired in inches

8) Field of view of the sky

Field = Apf / M where Apf is apparent field of eyepiece and M is magnification

Field = (Fs/F) * 57.29 where Fs = eyepiece field stop diameter and F = objective focal length.

Field = time / 4 where time = time for equatorial star to cross visual field in minutes.

9) Size of minumum size spot your telescope can produce (Airy disk)

$\rho = 1.22 * \lambda * f / D$ where ρ = physical size of radius of the spot (note dependant on focal ratio)

$\rho_a = 1.22 * \lambda / D$ where ρ_a = angular size of the radius of the spot

10) Resolving power of a telescope

R = 4.56 / D **Where R = arc sec and D is inches**

11) Diameter of spot in focal plane within which coma is tolerable.

$R = .00043 * (F / D)^3$

12) Minor axis of Newtonian Secondary

Ma = f + (a * (D – f) / F)

Where:

f = desired fully illuminated field of view desired
a = distance from center axis of primary to focal plane at the eyepiece
D = diameter of objective
F = focal length of objective

12) Offset of Newtonian secondary (by very simple approximation)

Offset = k * ma where k = .4 for f/6, .5 for f/5 , and .6 for f/4

Further reading

Astronomy, A Handbook
By Arthur Beer
Sky Publishing

Advanced Astronomers Handbook
By J. B. Sidgwick
Dover

Advanced Amateur Astronomy
By Gerald North
Edinburgh

How to Make a Telescope
Jean Texereau
Willmann – Bell

The Handbook of Astronomical Image Processing
By Richard Berry
Willmann – Bell

Making Your Own Telescope
By Allyn J. Thompson
Sky Publishing

Star Testing Astronomical Telescopes
By H. R. Suiter
Willmann - Bell