

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

$$M = F/f \quad \text{or} \quad D/d$$

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

$$M = 0.13 * D \quad \text{where D is mm}$$

$$M = 3.3 * D \quad \text{where D is inches}$$

5) Eyepiece for minimum magnification

$$f' = 7.7 * \text{focal ratio} \quad \text{where } f' \text{ is desired in mm}$$

$$f' = 0.3 * \text{focal ratio} \quad \text{where } f' \text{ is desired in inches (rarely the case)}$$

6) Maximum magnification (somewhat subjective)

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

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

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

7) Eyepiece for max magnification

$$f' = 0.90 * \text{focal ratio} \quad \text{where } f' \text{ is desired in mm}$$

$$f' = 0.033 * \text{focal ratio} \quad \text{where } f' \text{ is desired in inches}$$

8) Field of view of the sky

$$\text{Field} = \text{Apf} / \text{M} \quad \text{where Apf is apparent field of eyepiece and M is magnification}$$

$$\text{Field} = (\text{Fs}/\text{F}) * 57.29 \quad \text{where Fs = eyepiece field stop diameter and F = objective focal length.}$$

$$\text{Field} = \text{time} / 4 \quad \text{where time = time for equatorial star to cross visual field in minutes.}$$

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

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

$$\rho_a = 1.22 * \lambda / D \quad \text{where } \rho_a = \text{angular size of the radius of the spot}$$

10) Resolving power of a telescope

$$R = 4.56 / D \quad \text{Where } R = \text{arc sec} \text{ and } D \text{ is inches}$$

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)

$$\text{Offset} = k * ma \quad \text{where } k = .4 \text{ for } f/6, \text{ .5 for } f/5, \text{ and } .6 \text{ for } f/4$$

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