# The Astronomical League

A Federation of Astronomical Societies

## Astro Note D3 – **Considerations when Buying a Telescope**

**Introduction** – One of the most common questions asked of amateur astronomers is advice on purchasing a telescope. Many considerations are necessary to choose the right instrument to meet your observing needs. A few of those considerations are detailed here.

**Interest Level**

First, decide what the interest level is (or will be) of the potential telescope user: Which interest level best fits your intended use?

- Casual – This includes a child who has completed a science unit on astronomy in school or an adult who has a passing interest and wants to learn a little more. Do not confuse an interest in "space" with an interest in astronomy. If the interest wanes, for what else can the telescope be used?
- Special – A bright comet (e.g., Halley), lunar or solar eclipse, close approach of the planet Mars or other transient event might focus an otherwise casual interest. Consider the requirements of the special interest and potential uses of the telescope after the event is past.
- General – The user has some knowledge of the breadth of astronomy as a science, maybe from a college or adult education class. There has been some contact with active amateur astronomers, perhaps through a local astronomy club. While there is no specific area of particular interest, the user has had an opportunity to look at astronomical objects through a telescope.
- Critical You have a telescope now, but want another instead/besides that is more appropriate to a particular area of study. Such areas may include deep sky, planetary, solar, photography, photometry or others. If you are in this category, you should know just what you need.

**Try Before You Buy**

Join your local astronomy club. Most clubs have star parties, and they are great opportunities to look at and through various telescopes. Astronomers are usually anxious to tell others about their telescopes and observing experiences. You can get advice on telescopes and see which types of telescopes best meet your needs and desires.

Also, many astronomy clubs have telescope loaner or inexpensive rental programs. These provide an easy way for their members to try out telescopes for themselves without making a significant monetary investment first.

## The Powers of a Telescope

The purpose of using a telescope is to gather more light. It may use a concave mirror (reflecting telescope), a lens (refracting telescope) or a combination of the two (catadioptic telescope). The size of the objective element is the major characteristic to consider when deciding which telescope to buy.

- Light Gathering Power – Most astronomical objects are quite faint. A major purpose for a telescope is to collect as much light as possible and concentrate the light so the object appears brighter. Light gathering power depends on the area of the objective or the square of the objective's diameter.
- Resolving Power – The resolution of a telescope provides the ability to see fine detail. Although many factors influence resolution, resolving power depends on the diameter of the objective element.
- Magnifying Power – This is the commonly associated ability to make distant (small) objects appear nearer (larger). Many astronomical applications use relatively low magnifications. Theoretically, magnification above 50x per inch of objective element diameter is useless. Magnifications in the range of 15x - 30x per inch are more commonly used. Therefore, usable magnification depends on the diameter of the objective element.

Since all three "powers" depend on the diameter of the objective element, the general rule for astronomical use is: Buy the telescope with the largest diameter objective element that you can afford.

## Telescope Selection

- Binoculars – Often overlooked for astronomical use, binoculars provide an opportunity to explore the night sky with low magnification and a wide field of view. They are especially suitable for large nebulae, open star clusters and bright comets. Low magnification prohibits their use for planetary study. The relatively small size and light weight provide excellent portability and ease of use. You may already own binoculars, purchased for another purpose – use them for astronomy! The "7x50" models make excellent astronomical instruments and are available in the $50 - $100 range.
- Spotting Scopes – Most commonly found with 20x-25x magnification, higher priced models may include variable magnification. 60 - 80mm objective element diameters are readily available. Spotting scopes can be heavy to hold. Even 20x will require a tripod to steady the image for observing. The table-top tripod usually sold with spotting scopes seldom permits tilting them high enough to observe objects high in the sky. Plan on a sturdy camera tripod with an adapter to hold the scope. 20x will allow observing lunar craters, phases of Venus, Jupiter's four bright moons, Saturn's ring and its brightest moon – Titan. Do not expect to see detail on planet disks. Some star clusters and nebulae are spectacular in spotting scopes. In addition to astronomical uses, or if astronomical interest wanes, the scope can be used for bird watching, sporting events or hunting. Prices start about $75 and go up to several hundred. Plan on another $50 - $100 for a quality camera tripod.
- Small Refractors (60mm typical) – Widely available, these telescopes can be an amazing value for the money. Designed for astronomical use, their utility for

terrestrial observing is limited. Images are usually inverted and mirrored (upside down and/or backward) but this is not an issue for astronomy. Beware “cheap” models. Buy it from a reputable dealer and from a reputable manufacturer.

- Features to look for include:
    - Eyepiece barrels (that insert into the eyepiece holder) of 1-1/4 inches.
    - Interchangeable eyepieces to change magnifications
    - A separate "finder telescope" with "cross hairs" for locating objects
    - A "star diagonal" for comfortable overhead viewing
    - A sturdy tripod
    - An objective lens of at least 60mm diameter.

Beware of:

- A draw-tube for changing magnification
- A non-optical finder (sometimes just a peep sight or a long plastic tube)
- A flimsy tripod
- A claim of high magnification (anything over 100x generally is useless for these scopes).
- Be especially cautious of solar filters which attach to the eyepiece: if the scope has one of these, **throw it away – it is not safe**.

At magnifications up to 100x more lunar detail can be seen, some planetary features are visible (Mars' polar caps, Jupiter's main cloud belts, gaps in Saturn's ring), many double stars are "split" and a host of variable stars can be monitored. Prices start around $100 and go up, depending on the size and the accessories offered.

- Small Reflectors (4 to 6 inches) – Some of these telescopes can be good values and useful in observing. Follow the same guidelines for small refractors.
- Large Refractors (100 to 150 mm) – These telescopes are well made and provide significantly higher resolution, magnification, and light gathering capability. They tend to be very expensive and are intended for very serious amateur astronomers. They are an excellent astrophotography platform. Costs are usually in the thousands of dollars.
- Large Reflectors (above 8 inches) – These telescopes often represent a great value for price. They tend to be rather long and may be a challenge to move and set up. Due to their larger diameters, they provide higher resolution, magnification, and light gathering capability. Costs range from $400 upwards.
- Compound Telescopes – Also called catadioptic telescopes, these telescopes combine mirrors and lenses. They are mainly for someone with a known interest in astronomy. Objective Elements range from 3.5 to 39 inches. Generally, the 8-inch size is the best value. The smaller sizes are very compact and may be useful as a travel scope. The larger sizes almost require a permanent observatory for their practical use. If you are considering one of these scopes, you should know what you want and why. Prices for an 8-inch size range from $1000 - $2500, depending on the accessories offered.

**Mounting Options**

As the Earth rotates on its axis, the stars (and Sun and Moon) rise in the east, pass generally overhead and set in the west. A telescope's mounting must permit movement to

the desired object anywhere in the sky. The telescope must also be able to move to track the object as it drifts by. The altitude/azimuth and equatorial mountings are available.

- Altitude/Azimuth Mounting – These are simple mountings that let the telescope rotate to angles along the horizon (azimuth) and also change the height that they point to (altitude). They are easy to use and most often manually operated. This mounting type is often satisfactory for magnifications up to 100x and when you do not plan to do astrophotography.
- Equatorial Mounting – This mounting has one axis tilted to match the Earth's axis of rotation and makes tracking of astronomical objects easier. At high magnifications an equatorial mounting is usually required and it is a must for long exposure astronomical photography. While it may be available for smaller telescopes, the equatorial mount is usually not necessary for the beginning observer and it may add up to $100 to the telescope cost.
- Computerized Mounts – Although not required, the addition of a computer brings go-to capability to a telescope and also makes tracking automatic. This is a feature that is often more applicable to experience observers and astrophotographers. The addition of a computer to the telescope usually doubles the cost.