

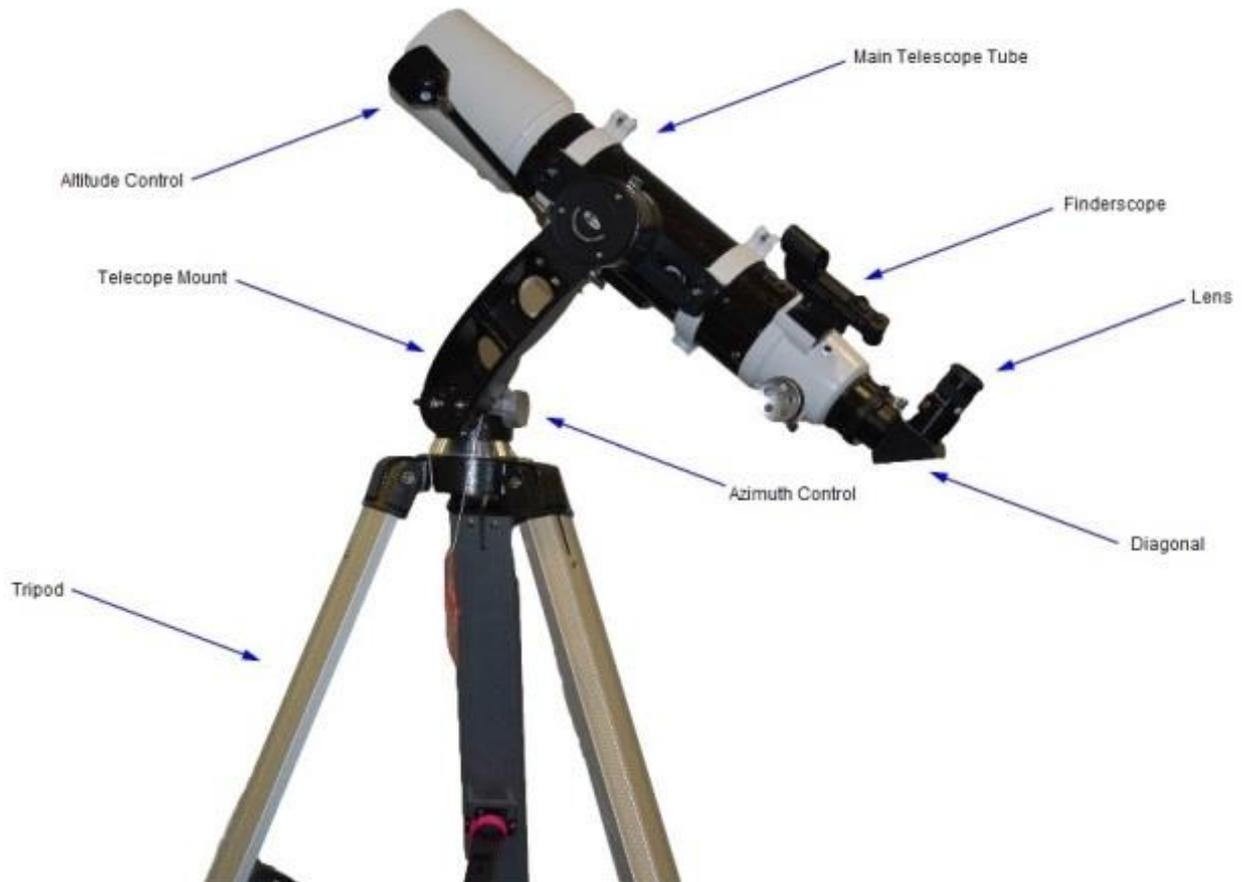
## Lending Telescope Collection

### ED80 Refractor Telescope Instruction Manual



**Warning:** Never look directly at the Sun through any telescope or finder scope – even for an instant – as permanent eye damage could result. Do not point the telescope at the Sun, as parts will melt. Children should use this telescope only with adult supervision.

## Telescope Components



### Transporting the Telescope.

The telescope kit comes in three parts:

- i) The optical tube in a hard case,
- ii) A hard case containing eyepieces and accessories,
- iii) The tripod with azimuth mount

Special care needs to be taken while transporting the telescope. Please plan your transport of the telescope to prevent it moving around and being damaged. The tube is quite heavy, and the collective parts do take up a lot of space. Please secure with a seat belt or other method if travelling with this across the back seat of a car.

## Care and Maintenance

### Cleaning the lenses or mirrors

Do not clean the lenses or mirrors. Let the library know if they seem dirty. Eyepieces can get dirty fairly quickly. Please don't poke them as it's very easy to scratch the coatings. However in the case of minor smudges, you might like to use the Lens pen, provided in the kit. First brush away any dust with the Pen. Then use the cleaning tip on the pen to clean the eyepiece. Be sure to keep the dust caps on the telescope when not in use.

### Fog on the lenses and eyepieces

It is normal for dew to form on all parts of the telescope while star gazing. Eyepieces will often have dew form on them, and are unusable until they warm up and dry out. If the eyepiece fogs up, wrap your hands around it for a few moments. As it warms up the fog should disappear. DO NOT wipe the lens with a tissue or cloth as it has special coatings on it that could be damaged if you do.

At the end of the night, you can take the telescope inside, and leave unpacked. This will allow any moisture that is in the telescope to dry out.

## Getting Started

### Assembling the telescope.

Please refer to the video for assembling the telescope. It can be found on the library website:

[www.library.camden.nsw.go.au](http://www.library.camden.nsw.go.au)

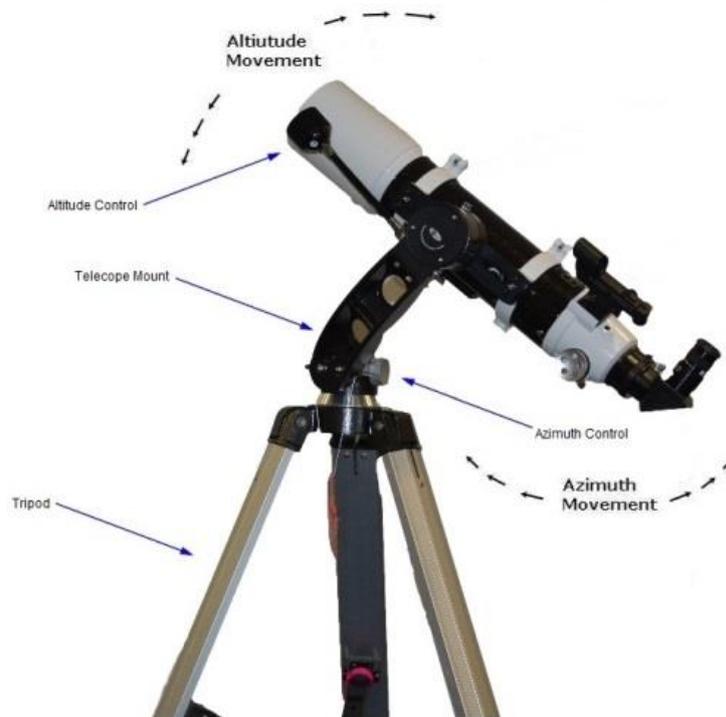
or on the DVD included in the telescope kit.

## Using the telescope

It is best to get a feel for the basic functions of the telescope during the day, before observing astronomical objects at night. This way you will be able to use the equipment with ease when it is dark and make the most of the night sky. Find a spot outdoors where you have plenty of room to move around the telescope, and where you have a clear view of an object or vista that is at least 500m away. It is not critical that the base be exactly level, but it should be placed on flat ground or pavement to ensure smooth movement of the telescope. Although we recommend familiarizing yourself with the equipment during daylight hours, it is critical that you never point the telescope at or near the Sun.

## Altitude and Azimuth

The Tripod allows the telescope to move along two axes: Altitude (up/down) and azimuth (left/right). Using the controls on the tripod allows you to move the telescope on these two axes.



Use the knob near the base of the telescope mount to move the telescope along the azimuth axes and use the motion control to move the telescope along the altitude axes. Both of these allow for smooth movements along both axes.

## Viewing with eyeglasses

If you wear eyeglasses, you may be able to keep them on while you observe, if the eyepieces have enough eye relief to allow you to see the whole field of view. You can try this by looking through the eyepiece first with your glasses on and then with them off, and see if the glasses restrict the view to only a portion of the full field. If they do, you can easily observe with your glasses off by just refocusing the telescope the needed amount. If you suffer from severe astigmatism, however, you may find images noticeably sharper with your glasses on. Then look through the telescope's eyepiece to see if that point is centered in the field of view. If it is, the job is done. If not, make the necessary adjustments.

## Aligning the Finderscope

The finder scope must be aligned accurately with the telescope for proper use. To align it, first aim the main telescope in the general direction of an object at least 500m away – a telegraph pole or a tree for example. Position the object in the center of the telescope's eyepiece.

Now look in the finder scope. Is the object visible? Ideally, it will be somewhere in the field of view. If it is not, some course adjustment of the two finder scope alignment thumb screws will be needed to get the finder scope roughly parallel to the main. With the image in the finder scope's field of view, you can now use the alignment screws to center the object on the intersection of the crosshairs.

By loosening one alignment thumb screw and tightening another you change the line of sight of the finder scope. Continue making adjustments to the various alignment thumb screws until the image in both the finder scope and the telescope's eyepiece is exactly centered. Check the alignment by moving the telescope to another object and fixing the finder scope's crosshairs on the exact point you want to look at.

Then look through the telescope's eyepiece to see if that point is centered in the field of view. If it is, the job is done. If not, make necessary adjustments until the two images match up. The finder scope alignment needs to be checked before every observing session.

#### Focusing the Finder scope

If, when looking through the finder scope, the images appear somewhat out of focus, you will need to refocus the finder scope for your eyes. Loosen the lock ring located behind the objective lens cell on the body of the finder scope. Back the lock ring off by a few turns. Refocus the finder scope on a distant object by threading the objective lens cell in or out on the finder scope body. Precise focusing can be achieved by focusing the finder scope on a bright star. Once the image appears sharp, retighten the lock ring behind the objective lens cell.

#### Aiming / Pointing the telescope

With the finder scope aligned, the telescope can be quickly and accurately pointed at anything you wish to observe. The finder scope has a much wider field of view than the telescope's eyepiece, and therefore it is much easier to center an object in the finder scope. Then, if the finder scope is accurately aligned, the object will be centered in the telescope's field of view.

Start by once again moving the telescope until it is pointed in the general direction of the object you want to see. Some observers find it convenient to sight along the tube to do this. Now, look in the finder scope. If your general aim is accurate, the object should appear somewhere in the field of view. Make small adjustments to the telescope's position until the object is centered on the finder's crosshairs.

#### Focusing the telescope

Insert the low power 25mm eyepiece into the focuser and secure it with the thumb screw. Move the telescope so the front (open) end is pointing in the general direction of an object at least 250m away. Now, slowly rotate one of the focusing nobs until the object comes into sharp focus. Go a little bit beyond sharp focus until the image starts to blur again, then reverse back to focus – just to make sure you have hit the exact focus point.

If you have trouble focusing, rotate the focusing knob so the drawtube is in as far as it will go. Now look through the eyepiece while slowly rotating the focusing knob in the opposite direction. You

should soon see the point at which focus is reached. On the underside of the focuser there are two metal thumbscrews. The thumbscrew closest to the body of the scope will lock the focuser position, the other thumbscrew will adjust focuser tension.

## Observing Tips

### Site selection

Pick a location away from street lights and bright yard lighting. Avoid viewing over rooftops and chimneys, as they often have warm air currents rising from the, which distort the image seen in the eyepiece. You should also not observe out an open window from indoors for the same reason. The best options would be out of town, away from light pollution. Most importantly, make sure that any chosen site has a clear view of a large portion of the sky.

### Seeing and Transparency

Atmospheric conditions play a huge part in the quality of viewing. In good conditions, star twinkling is minimal and objects appear steady in the eyepiece. Seeing is best overhead, worst at the horizon. Also seeing is generally better after midnight, when much of the heat absorbed by the Earth during the day has radiated off into space.

Typically, seeing conditions will be better at sites that have an altitude over 3000 feet. Altitude helps because it decreases the amount of distortion causing atmosphere you are looking through.

A good way to judge if the seeing is good or not is to look at bright stars about 40° above the horizon. If the stars appear to twinkle, the atmosphere is significantly distorting the incoming light, and views at high magnification will not appear sharp. If the stars appear steady and do not twinkle, seeing conditions are probably good, and higher magnifications will be possible.

Good transparency is especially important for observing faint objects. It simply means the air is free of moisture, smoke and dust. Which all tend to scatter light, reducing an object's brightness.

### Cooling the telescope

All optical instruments need time to reach thermal equilibrium to achieve maximum stability of lenses and mirrors, which is essential for good performance of the telescope. When moved from a warm indoor location, outside to cooler air a telescope needs time to cool to the ambient temperature.

A cooling fan is at the base of the telescope to assist in the cooling down period prior to use. The battery pack for the fan, is attached with velcro to the base of the telescope. The fan should be switched off after the telescope has cooled down, and before observing.

### Let your eyes adjust to the dark

Do not expect to go from a lighted house into the darkness of night outdoors and immediately be able to see faint objects. Your eyes take about 30minutes to reach approx. 80% of their full dark-adapted sensitivity. Many observers notice improvements after several hours of darkness. As your

eyes become dark adapted, more stars will glimmer into view and you will be able to fainter details in objects.

To see what you are doing in the darkness use the red filtered flashlight – there is one included in the kit. Red light does not spoil your eyes dark adaptation. Beware too that nearby porch and street lights and car headlights will spoil your night vision.

## **Tracking Celestial Objects**

The Earth is constantly rotating about its polar axis, completing one full rotation every 24 hours; this is what defines a “day”. We do not feel the Earth rotating, but we can tell that it is at night by seeing the apparent movement of stars from east to west. This movement translates into a rate of  $.25^\circ$  per minute, or arc-seconds per second. (There are 60 arc-minutes in  $1^\circ$ , and 60 arc-seconds in one arc-minute.) This is called the sidereal rate. When you observe any astronomical object, you are watching a moving target. This means the telescope’s position must slowly be updated over time to keep an object in the field of view. To keep the object in the telescope’s field of view (to “track” it), the telescope must be moved by small increments every now and then, in the direction the object is moving. The smooth motion provided by the telescope mount allows easy moving along both axes. The dual controls can be easily used concurrently, if need, to follow objects effectively.

### Eyepiece Selection

By using eyepieces of varying focal lengths, it is possible to attain many magnifications. The telescopes come with two high-quality eyepieces: a 25mm, which gives a magnification of 80x and 83x, and a 9mm, which gives a magnification of 139x and 133x. It is quite common for an observer to own five or more eyepieces to access a wide range of magnifications. This allows the observer to choose the best eyepiece to use depending on the object being viewed. At least to begin with, the three supplied eyepieces will suffice just nicely. Whatever you choose to view, always start by inserting your lowest power (longest focal length) eyepiece to locate and center the object. Low magnification yields a wide field of view, which shows a larger area of sky in the eyepiece. This makes acquiring and centering an object much easier. Once you’ve centered an object in the eyepiece, you can switch to higher magnification (shorter focal length eyepiece), if you wish. This is especially recommended for small and bright objects, like planets and double stars. The moon also takes higher magnifications as well.

Deep sky objects, however, typically look better at medium or low magnifications. This is because many of them are quite faint, yet have some extent (apparent width). Deep-sky objects will often disappear at higher magnifications, since greater magnification inherently yields dimmer images. This is not the case for all deep-sky objects, however. Many galaxies are quite small, yet are somewhat bright, so higher power may show more detail. The best rule of thumb with eyepiece selection is to start with a low power, wide field, and then work your way up in magnification. If the

object looks better, try an even higher magnification. If the object looks worse, then back off the magnification a little by using a lower power eyepiece.

### Field of View

One of the most important considerations with eyepieces is also the most overlooked consideration when making an eyepiece selection. In all star charts or catalogs the suggested power is never mentioned. Deep-sky objects are always shown by their size. The size is nearly always shown in arc-minutes. To determine the field of view of any given eyepiece follow this simple formula:

Each type of eyepiece has an apparent field of view (e.g. Plossl = 50° Apparent field)

Divide the Apparent field by the magnification.

The answer will be the Real field of view in degrees.

Multiply this answer by 60 and you will have the field of view in arc-minutes.

Now pick the eyepiece that the object fits into and enjoy the view. It will be much better than just going by power alone.

## **Objects to Observe**

Now that you are all set up and ready to go, one critical decision must be made: what to look at?

### The Moon

With its rocky surface, the Moon is one of the easiest and most interesting targets to view with your telescope. Lunar craters, maria, and even mountain ranges can all be clearly seen from an average distance of 350,000kms away. With its ever-changing phases, you'll get a new view of the Moon every night. The best time to observe our one and only natural satellite is during a partial phase, that is, when the Moon is NOT full. During partial phases, shadows are cast on the surface, which reveal more detail, especially right along the border between the dark and light portions of the disk (called the "terminator"). A full moon is too bright and devoid of surface shadows to yield a pleasing view. Make sure to observe the Moon when it is well above the horizon to get the sharpest images.

Use the included Moon filter to dim the Moon when it is very bright. It simply threads onto the bottom of the eyepieces (you must first remove the eyepiece from the focuser to attach a filter). You'll find that the Moon filter improves viewing comfort, and also helps to bring out subtle features on the lunar surface. Some coloured filters also help to cast different shadows.

## The Planets

The planets don't stay put like the stars, so to find them you should refer to our charts published monthly in our newsletter Night Sky or astronomy magazines like Sky and Space, Sky and Telescope. Venus, Mars, Jupiter and Saturn are the brightest objects in the sky after the Sun and the Moon.

The telescope is capable of showing you these planets in some detail. Other planets may be visible but will appear star-like. Because planets are quite small in apparent size, optional higher power eyepieces are recommended and are often needed for detailed observations. Not all the planets are generally visible at any one time.

**Jupiter** The largest planet, Jupiter, is a great subject for observation. You can see the disk of the giant planet and watch the ever-changing positions of its four largest moons – Io, Callisto, Europa, and Ganymede. Higher power eyepieces should bring out the bands on the planet's disk.

**Saturn** The ringed planet is a breathtaking sight when it is well positioned. The tilt angle of the rings varies over a period of many years; sometimes they are seen edge-on, while at other times they are broadside and look like giant "ears" on each side of Saturn's disk. A steady atmosphere is necessary for a good view. You will probably see a bright "star" close by, which is Saturn's brightest moon, Titan.

**Venus** At its brightest, Venus is the most luminous object in the sky, excluding the Sun and the Moon. It is so bright that sometimes it is visible to the naked eye during full daylight! Ironically, Venus appears as thin as a crescent, not a full disk, when at its peak brightness. Because it is so close to the Sun, it never wanders too far from the morning or evening horizon. No surface markings can be seen on Venus, which is always shrouded in dense clouds.

**Mars** The Red Planet makes its closest approach to Earth every two years. During close approaches you'll see a red disk, and may be able to see the polar ice cap. To see surface detail on Mars, you will need a high power eyepiece and very steady air!

## The Stars

Stars will appear like twinkling points of light. Even powerful telescopes cannot magnify stars to appear as more than a point of light! You can, however, enjoy the different colours of the stars and locate many pretty double and multiple stars. The famous "Alpha Centauri" in the constellation Centaurus and the gorgeous two-colour double star Albireo in Cygnus are favourites. Defocusing a star slightly can help bring out its colour.

## Deep-Sky Objects

Under dark skies, you can observe a wealth of fascinating deep-sky objects, including gaseous nebulae, open and Globular star clusters, and a variety of different types of galaxies. Most deep-sky objects are very faint, so it is important that you find an observing site well-away from light pollution. Take plenty of time to let your eyes adjust to the darkness. Do not expect these objects to appear like the photographs you see in books and magazines; most will look like dim gray smudges.