INSTRUCTION MANUAL

Orion®
EQ-2 Equatorial Mount

#9019

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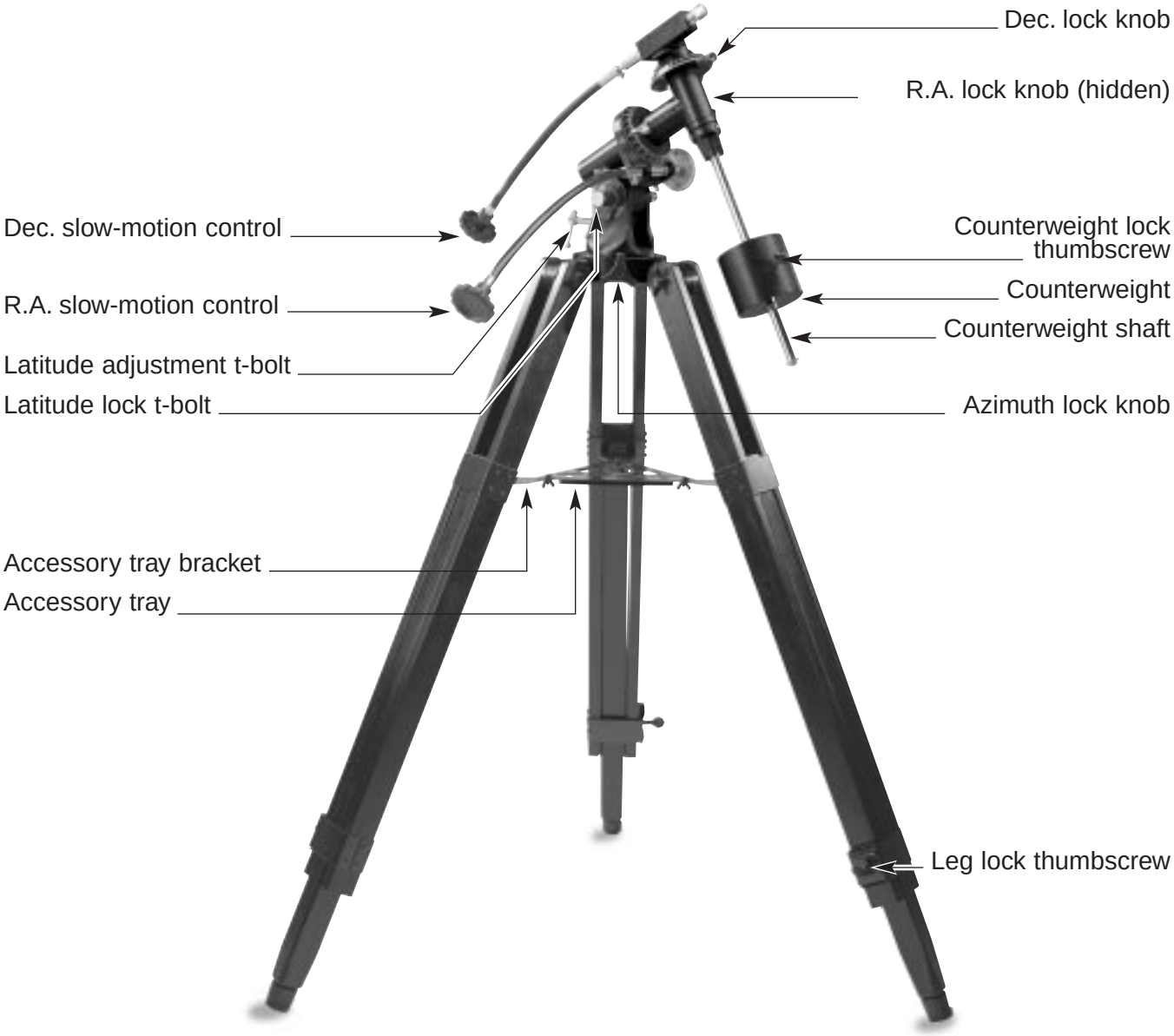


Figure 1. EQ-2 Equatorial Mount parts diagram

Congratulations on your purchase of a quality Orion product. Your new Orion EQ-2 Equatorial Mount was designed to work with many different telescope optical tubes. Designed for astronomical use, this precision mount allows convenient manual "tracking" of celestial objects as they move slowly across the sky, so they remain within your eyepiece's field of view. The setting circles will assist you in locating hundreds of fascinating celestial denizens, including galaxies, nebulas, and star clusters, from their catalogued coordinates. With a little practice and a little patience, you will find that your EQ-2 Equatorial Mount is an invaluable tool for getting the most out of your astronomical observing sessions.

These instructions will help you set up and properly use your equatorial mount. Please read them over thoroughly before getting started.

Table of Contents

1. Parts List

Qty.	Description
1	German-type equatorial mount
2	Slow-motion control cables
1	Counterweight
1	Counterweight shaft
3	Tripod legs w/attachment bolts
1	Accessory tray w/mounting hardware
2	Assembly tools (wrench, Phillips-head screwdriver)

2. Assembly

Carefully open all of the boxes in the shipping container. Make sure all the parts listed in Section 1 are present. Save the original boxes and packaging material. In the unlikely event that you need to return the telescope, you must use the original packaging.

Assembling the mount for the first time should take about 20 minutes. No tools are needed, other than the ones provided. All bolts should be tightened securely to eliminate flexing and wobbling, but be careful not to over-tighten or the threads may strip. Refer to Figure 1 during the assembly process.

1. Lay the equatorial mount on its side. Attach the tripod legs one at a time to the mount by sliding the bolts installed in the tops of the tripod legs into the slots at the base of the mount and tightening the wingnuts finger-tight. Note that the accessory tray bracket on each leg should face inward.
2. Tighten the leg lock thumbscrews at the base of the tripod legs. For now, keep the legs at their shortest (fully retracted) length; you can extend them to a more desirable length later, after the scope is completely assembled.
3. With the tripod legs now attached to the equatorial mount, stand the tripod upright (be careful!) and spread the legs apart enough to connect the accessory tray to the bracket on each leg. Use the small screws and wingnuts to do this.
4. Now, with the accessory tray bracket attached, spread the tripod legs apart as far as they will go, until the bracket is taut. Tighten the bolts at the tops of the tripod legs, so the legs are securely fastened to the equatorial mount. Use the wrench and your fingers to do this.

5. Orient the equatorial mount as it appears in Figure 1, at a latitude of about 40°, i.e., so the pointer next to the latitude scale (located directly above the latitude lock t-bolt) is pointing to the hash mark at “40.” To do this, loosen the latitude lock t-bolt, and turn the latitude adjustment t-bolt until the pointer and the “40” line up. Then tighten the latitude lock t-bolt. The declination (Dec.) and right ascension (R.A.) axes many need repositioning (rotation) as well. Be sure to loosen the R.A. and Dec. lock knobs before doing this. Retighten the R.A. and Dec. lock knobs once the equatorial mount is properly oriented.
6. Slide the counterweight onto the counterweight shaft. Make sure the counterweight lock thumbscrew is adequately loosened so the metal pin the thumbscrew pushes against (inside the counterweight) is recessed enough to allow the counterweight shaft to pass through the hole in the counterweight.
7. With the counterweight lock thumbscrew still loose, grip the counterweight with one hand and thread the shaft into the equatorial mount (at the base of the declination axis) with the other hand. When it is threaded as far in as it will go, position the counterweight about halfway up the shaft and tighten the counterweight lock thumbscrew.
8. Now attach the two slow-motion cables to the R.A. and Dec. worm gear shafts of the equatorial mount by positioning the setscrew on the end of the cable over the indented slot on the worm gear shaft and then tightening the setscrew.

3. Attaching a Telescope

The EQ-2 Equatorial Mount is designed to hold small to mid-size telescopes weighing up to about 10 lbs. For heavier telescopes, the mount may not provide sufficient stability for steady imaging. Any type of telescope can be mounted on the EQ-2, including refractors, Newtonian reflectors, and catadioptrics, provided a proper adapter or pair of tube rings is available to provide secure coupling.

Orion carries a variety of differently sized tube rings and a 1/4"-20 mounting adapter designed exclusively for the EQ-2 mount. One of these items will probably fit the telescope tube you wish to mount. See the list of Suggested Accessories at the end of these instructions, or check the Orion print or online catalogs for currently available mounting accessories.

4. Balancing the Telescope

Once the telescope is attached to the equatorial mount, the next step is to balance the telescope. Proper balance is required to insure smooth movement of the telescope on both axes of the equatorial mount.

If you attach your telescope with a 1/4"-20 adapter, it may not be possible to balance the scope precisely with respect to the declination axis, because the telescope cannot be adjusted back and forth as it can when tube rings are used.

Assuming you will be using tube rings, we will first balance the telescope with respect to the R.A. axis, then the Dec. axis.

1. Keeping one hand on the telescope optical tube, loosen the R.A. lock knob. Make sure the Dec. lock knob is locked, for now. The telescope should now be able to rotate freely about the R.A. axis. Rotate it until the counterweight shaft is parallel to the ground (i.e., horizontal).
2. Now loosen the counterweight lock thumbscrew and slide the weight along the shaft until it exactly counterbalances the telescope (Figure 2a). That’s the point at which the shaft remains horizontal even when you let go of the telescope with both hands (Figure 2b). If you position the counterweight all the way at the end of the shaft (near the retaining bolt and washer) and it still does not counterbalance the telescope, you will need to purchase an additional counterweight (Orion part number #65024). Retighten the counterweight lock thumbscrew. The telescope is now balanced on the R.A. axis.
3. To balance the telescope on the Dec. axis, first tighten the R.A. lock knob, with the counterweight shaft still in the horizontal position.
4. With one hand on the telescope optical tube, loosen the Dec. lock knob (Figure 2c). The telescope should now be able to rotate freely about the Dec. axis. Loosen the tube ring clamps a few turns until you can slide the telescope tube forward and back inside the rings (Figure 2d); this can be aided by using a slight twisting motion on the optical tube while you push or pull on it. Position the telescope so that it remains horizontal when you carefully let go with both hands (Figure 2e). This is the balance point for the Dec. axis. Before clamping the rings tight again, rotate the telescope so the eyepiece is positioned at a convenient angle for viewing (this is not possible if using a 1/4"-20 mounting adapter).

The telescope is now balanced on both axes. Now when you loosen the lock knob on one or both axes and manually point the telescope, it should move without resistance and should not drift from where you point it.

5. Setting Up and Using the Equatorial Mount

When you look at the night sky, you no doubt have noticed that the stars appear to move slowly from east to west over time. That apparent motion is caused by the Earth's rotation (from west to east). An equatorial mount (Figure 3) is designed to compensate for that motion, enabling you to easily "track" the movement of astronomical objects, thereby keeping them from drifting out of the telescope's field of view while you're observing.

This is accomplished by slowly rotating the telescope on its right ascension (polar) axis, using only the R.A. slow-motion cable. But first the R.A. axis of the mount must be aligned with the Earth's rotational (polar) axis—a process called polar alignment.

Polar Alignment

For Northern Hemisphere observers, approximate polar alignment is achieved by pointing the mount's R.A. axis at the North Star, or Polaris. It lies within 1 degree of the north celestial pole (NCP), which is an extension of the Earth's rotational axis out into space. Stars in the Northern Hemisphere appear to revolve around Polaris.

To find Polaris in the sky, look north and locate the pattern of the Big Dipper (Figure 4). The two stars at the end of the "bowl" of the Big Dipper point right to Polaris, which lies at a distance of about five times the separation of the two bowl stars.

Observers in the Southern Hemisphere aren't so fortunate to have a bright star so near the south celestial pole (SCP). The star Sigma Octantis lies about 1 degree from the SCP, but it is barely visible with the naked eye (magnitude 5.5).

For general visual observation, an approximate polar alignment is sufficient:

1. Level the equatorial mount by adjusting the length of the three tripod legs.
2. Loosen the latitude lock t-bolt. Turn the latitude adjustment t-bolt and tilt the mount until the pointer on the latitude scale is set at the latitude of your observing site. If you don't know your latitude, consult a geographical atlas to find it. For example, if your latitude is 35° North, set the pointer to +35. Then retighten the latitude lock t-bolt. The latitude setting should not have to be adjusted again unless you move to a different viewing location some distance away.
3. Loosen the Dec. lock knob and rotate the telescope optical tube until it is parallel with the R.A. axis. The pointer on the Dec. setting circle should read 90°. Retighten the Dec. lock knob.
4. Loosen the azimuth lock knob and rotate the entire equatorial mount left-to-right so the telescope tube (and R.A. axis) points roughly at Polaris. If you cannot see Polaris directly from your observing site, consult a compass and rotate the equatorial mount so the telescope points North. Retighten the azimuth lock knob.

The equatorial mount is now approximately polar-aligned for casual observing. More precise polar alignment is required for astrophotography. Several methods exist and are described in many amateur astronomy reference books.

Note: From this point on in your observing session, you should not make any further adjustments in the azimuth or the latitude of the mount, nor should you move the tripod. Doing so will undo the polar alignment. The telescope should be moved only about its R.A. and Dec. axes.

Tracking Celestial Objects

When you observe a celestial object through the telescope, you'll see it drift slowly across the field of view. To keep it in the field, if your equatorial mount is polar-aligned, just turn the R.A. slow-motion control. The Dec. slow-motion control is not needed for tracking. Objects will appear to move faster at higher magnifications, because the field of view is narrower.

Optional Motor Drives for Automatic Tracking and Astrophotography

An optional DC motor drive (EQ-2M, Orion part #7827) can be mounted on the R.A. axis of the EQ-2 equatorial mount to provide hands-free tracking. Objects will then remain stationary in the field of view without any manual adjustment of the R.A. slow-motion control. The motor drive is necessary for astrophotography.

Understanding the Setting Circles

The setting circles on an equatorial mount enable the location of astronomical objects by their "celestial coordinates." Every astronomical object resides in a specific location on the "celestial sphere." That location is denoted by two numbers: its right ascension (R.A.) and declination (Dec.). In the same way, every location on Earth can be described by its longitude and latitude. R.A. is similar to longitude on Earth, and Dec. is similar

to latitude. The R.A. and Dec. values for celestial objects can be found in any star atlas or star catalog.

So, the coordinates for the Orion Nebula listed in a star atlas will look like this:

R.A. 5h 35.4m Dec. -5° 27'

That's 5 hours and 35.4 minutes in right ascension, and -5 degrees and 27 arc-minutes in declination (the negative sign denotes south of the celestial equator). There are 60 minutes in 1 hour of R.A, and 60 arc-minutes in 1 degree of declination.

The telescope's R.A. setting circle is scaled in hours, from 1 through 24, with small hash marks in between representing 10-minute increments. The lower set of numbers (closest to the plastic R.A. gear cover) apply to viewing in the Northern Hemisphere, while the numbers above them apply to viewing in the Southern Hemisphere. The Dec. setting circle is scaled in 1° increments.

Before you can use the setting circles to locate objects, the mount must be well polar aligned, and the setting circles must be calibrated. The declination setting circle was calibrated at the factory, and should read 90° when the telescope optical tube is parallel with the R.A. axis.

Calibrating the Right Ascension Setting Circle

1. Identify a bright star near the celestial equator and look up its coordinates in a star atlas.
2. Loosen the R.A. and Dec. lock knobs on the equatorial mount, so the telescope optical tube can move freely.
3 Point the telescope at the bright star near the celestial equator whose coordinates you know. Center the star in the telescope's field of view. Lock the R.A. and Dec. lock knobs.
4. Rotate the R.A. setting circle so the pointer indicates the R.A. listed for the bright star in the star atlas.

Finding Objects With the Setting Circles

Now that both setting circles are calibrated, look up in a star atlas or observing guide the coordinates of an object you wish to view.

1. Loosen the Dec. lock knob and rotate the telescope until the Dec. value from the star atlas matches the reading on the Dec. setting circle. Retighten the lock knob. Note: If the telescope is aimed south and the Dec. setting circle pointer passes the 0° indicator, the value on the Dec. setting circle becomes a negative number.
2. Loosen the R.A. lock knob and rotate the telescope until the R.A. value from the star atlas matches the reading on the R.A. setting circle. Retighten the lock knob.

Most setting circles are not accurate enough to put an object dead-center in your finder scope's field of view, but they'll get you close, assuming the equatorial mount is accurately polar-aligned. The R.A. setting circle should be recalibrated every time you wish to locate a new object. Do so by calibrating the setting circle for the centered object before moving on to the next one.

Confused About Pointing the Telescope?

Beginners occasionally experience some confusion about how to point the mount overhead or in other directions. In Figure 1 the mount is pointed north as it would be during polar alignment. The counterweight shaft is oriented downward. But it will not look like that when the telescope is pointed in other directions. Let's say you want to view an object that is directly overhead, at the zenith. How do you do it?

One thing you DO NOT do is make any adjustment to the latitude adjustment t-bolt. That will undo the mount's polar alignment. Remember, once the mount is polar-aligned, the telescope should be moved only on the R.A. and Dec. axes. To point the scope overhead, first loosen the R.A. lock knob and rotate the telescope on the R.A. axis until the counterweight shaft is horizontal (parallel to the ground). Then loosen the Dec. lock knob and rotate the telescope until it is pointing straight overhead. The counterweight shaft is still horizontal. Then retighten both lock knobs.

Similarly, to point the telescope directly south, the counterweight shaft should again be horizontal. Then you simply rotate the scope on the Dec. axis until it points in the south direction (Figure 5a).

What if you need to aim the telescope directly north, but at an object that is nearer to the horizon than Polaris? You can't do it with the counterweight down as pictured in Figure 1. Again, you have to rotate the scope in R.A. so that the counterweight shaft is positioned horizontally. Then rotate the scope in Dec. so it points to where you want it near the horizon (Figure 5b).

To point the telescope to the east (Figure 5c) or west (Figure 5d), or in other directions, you rotate the telescope on its R.A. and Dec. axes. Depending on the altitude of the object you want to observe, the counterweight shaft will be oriented somewhere between vertical and horizontal.

The key things to remember when pointing the telescope is that a) you only move it in R.A. and Dec., not in azimuth or latitude (altitude), and b) the counterweight and shaft will not always appear as it does in Figure 1. In fact it almost never will!

6. Specifications

Mount: German-type equatorial

Tripod: wood, black

Height: 36" to 57"

Weight: 19 lbs.

Counterweight: 4.8 lb., supplied

Maximum Loading Weight: about 10 lbs.

Slow-Motion Adjustment: on both R.A. and Dec. axes

Setting Circles: R.A. scaled in 10-min. increments, Dec. scaled in 1° increments, for N or S Hemisphere

Altitude Adjustment: 5° to 75°

7. Suggested Accessories

1/4"-20 Adapter (Orion part #10101)

This accessory bolts to the top of the equatorial head and provides a threaded post on which to mount a camera or telescope that utilizes a standard 1/4"-20 thread.

Tube Mounting Rings

These quality metal rings are custom-made for use with the EQ-2 Mount. They are hinged for easy installation of a telescope tube and are lined with felt to prevent scratching. Check the outer diameter of your telescope; if it matches the inner diameter (I.D.) of the rings, then the rings will fit. If the outer diameter of your telescope is a little smaller than the I.D. of the rings, that is also acceptable; you can “shim” the inside of the rings with extra felt. Two rings are included in each set.

I.D. 3.0": Orion part #7369

I.D. 3.5": Orion part #7370

I.D. 3.9": Orion part #7371

I.D. 4.6": Orion part #7372

I.D. 5.5": Orion part #7373

EQ-2M Motor Drive (Orion part #7827)

This is a small electric motor that attaches to the equatorial mount. It turns the gear on the R.A. axis at the same rate the Earth rotates on its axis, thereby following, or “tracking,” the apparent motion of the stars. Automatic tracking keeps objects from drifting out of the field of view while you’re observing, and is required for astrophotography. Runs on four D-cell batteries.

Extra Counterweight (Orion part #65024)

Required if your telescope does not balance on the R.A. axis with the supplied 4.8-lb. counterweight. The additional counterweight weighs 4.8 lbs.

Figure 2a. Balancing the telescope with respect to the R.A. axis by sliding the counterweight along its shaft.

Figure 2b. Telescope is now balanced on the R.A. axis. That is, when hands are released, counterweight shaft remains horizontal.

Figure 2c. Preparing the telescope to be balanced on the Dec. axis by first releasing the Dec. lock knob.

Figure 2d. Balancing the telescope with respect to the Dec. axis. As shown here, the telescope is out of balance (tilting).

Figure 2e. Telescope is now balanced on the Dec. axis, i.e., it remains horizontal when hands are released.

Figure 2. Balancing the telescope

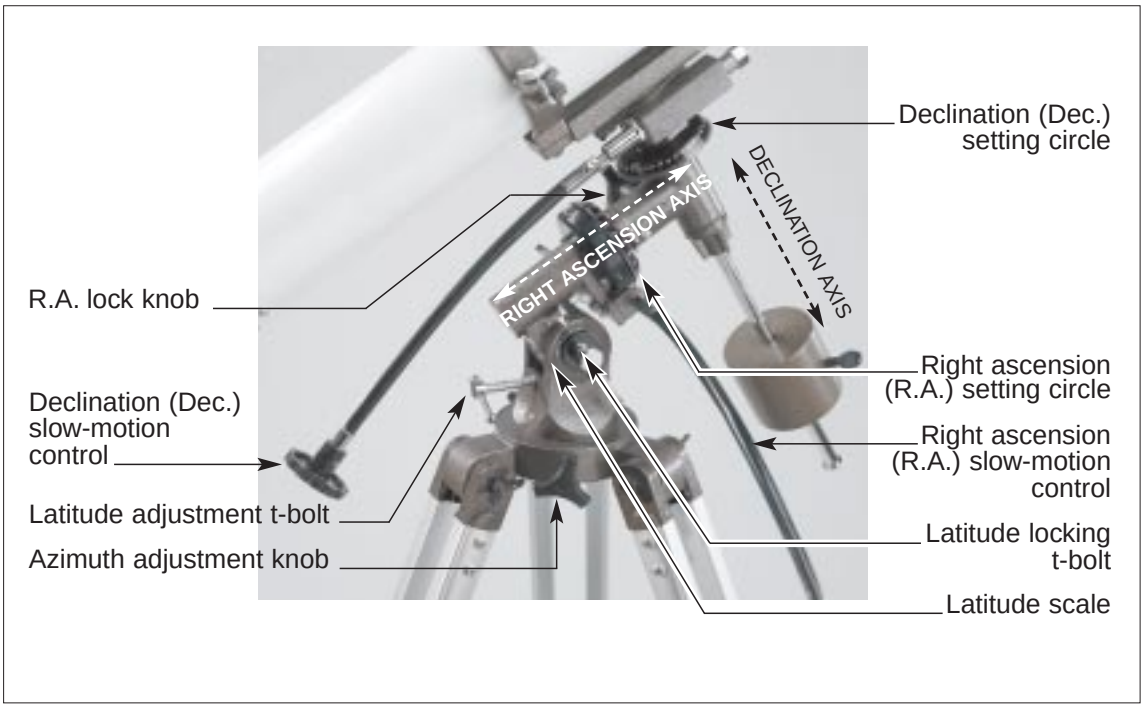
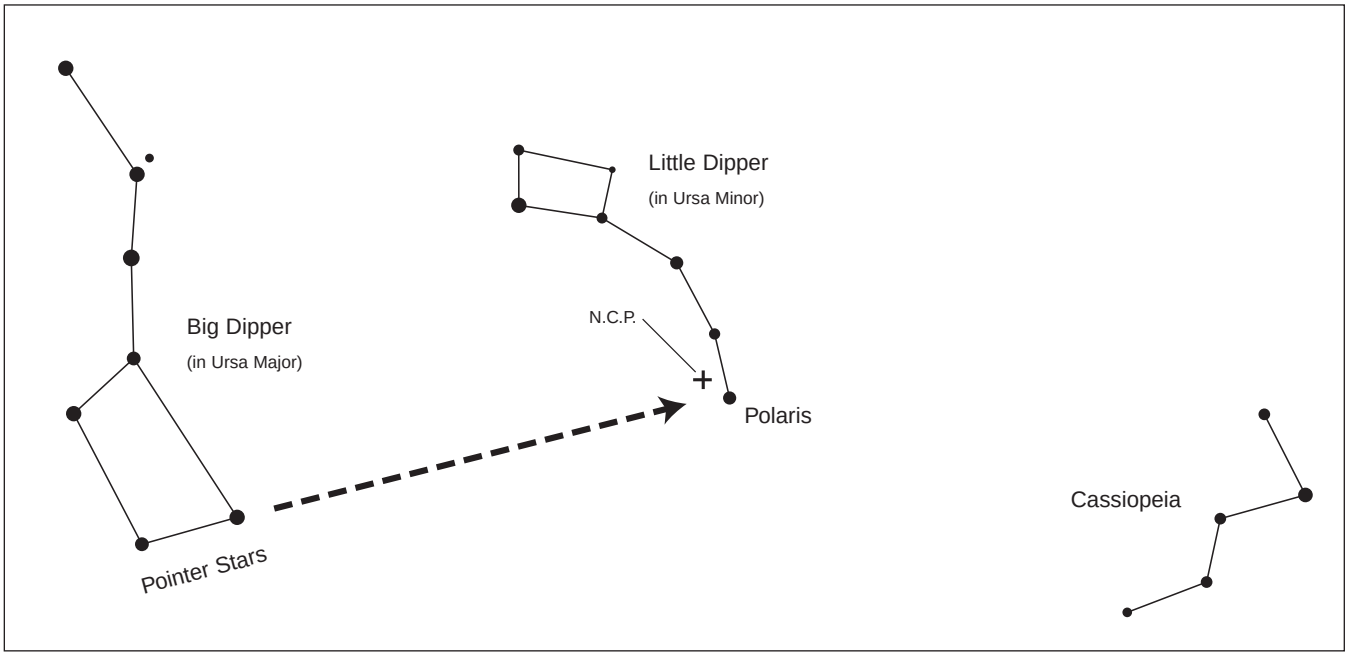


Figure 3. The equatorial mount



To find Polaris in the night sky, look north and find the Big Dipper. Extend an imaginary line from the two “Pointer Stars” in the bowl of the Big Dipper. Go about 5 times the distance between those stars and you’ll reach Polaris, which lies within 1° of the north celestial pole (NCP).

Figure 4. Finding Polaris

Figure 5a. Telescope pointing south. Note that in all these illustrations, the mount and tripod remain stationary; only the R.A. and Dec. axes are moved.

Figure 5b. Telescope pointing north.

Figure 5c. Telescope pointing east.

Figure 5d. Telescope pointing west.

Figure 5. Pointing the telescope

One-Year Limited Warranty

This Orion EQ-2 Equatorial Mount is warranted against defects in materials or workmanship for a period of one year from the date of purchase. This warranty is for the benefit of the original retail purchaser only. During this warranty period Orion Telescopes & Binoculars will repair or replace, at Orion's option, any warranted instrument that proves to be defective, provided it is returned postage paid to: Orion Warranty Repair, 89 Hangar Way, Watsonville, CA 95076. If the product is not registered, proof of purchase (such as a copy of the original invoice) is required.

This warranty does not apply if, in Orion's judgment, the instrument has been abused, mishandled, or modified, nor does it apply to normal wear and tear. This warranty gives you specific legal rights, and you may also have other rights, which vary from state to state. For further warranty service information, contact: Customer Service Department, Orion Telescopes & Binoculars, P. O. Box 1815, Santa Cruz, CA 95061; (800) 676-1343.

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