INSTRUCTION MANUAL

Orion®
EQ-2 Equatorial Mount

#9828 Equatorial Mount

ORION
TELESCOPES & BINOCULARS
Providing Exceptional Consumer Optical Products Since 1975

Customer Support (800) 676-1343
E-mail: support@telescope.com
Corporate Offices (831) 763-7000
P.O. Box 1815, Santa Cruz, CA 95061

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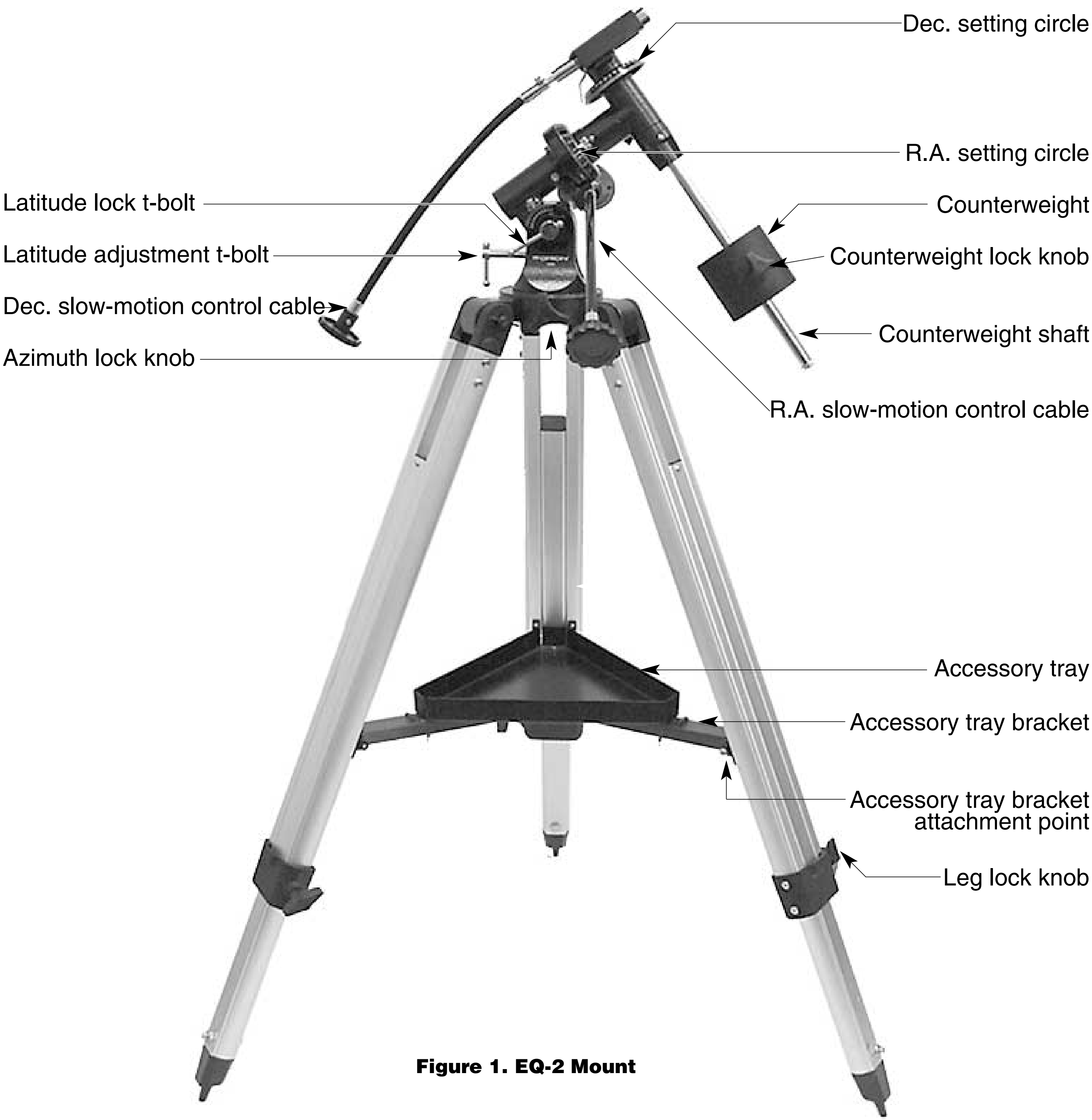

Figure 1. EQ-2 Mount

Congratulations on your purchase of a quality Orion product. Your new 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'll 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.

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1. Unpacking

The entire mount will arrive in one box. Be careful unpacking the box. We recommend keeping the box and all the internal shipping containers. In the event that the mount needs to be shipped to another location, or returned to Orion for warranty repair, having the proper box and internal shipping containers will help ensure that your mount will survive the journey intact.

Make sure all the parts in the Parts List are present. Be sure to check all packaging carefully, as some parts are small. If anything appears to be missing or broken, immediately call Orion Customer Support (800-676-1343) or email support@telescope.com for assistance.

Parts List

Box #1: Optical Tube Assembly and Accessories

Qty.	Description
1	German-type equatorial mount
2	Slow-motion control cables
1	Counterweight
1	Counterweight shaft
3	Tripod legs w/attachment bolts
1	Tripod accessory tray w/mounting hardware
1	Accessory tray bracket

2. Assembly

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 wing nuts finger-tight. Note that the accessory tray bracket attachment point on each leg should face inward.
2. Tighten the leg lock knobs on the bottom braces 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 telescope 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 each end of the accessory tray bracket to the attachment point on each leg. Use the screw that comes installed in each attachment point to do this. First remove the screw using the supplied screwdriver, then line up one of the ends of the bracket with the attachment point and reinstall the screw. Make sure that the accessory tray bracket is oriented so that the ribs in its plastic molding face downwards.
4. Now, with the accessory tray bracket attached, spread the tripod legs apart as far as they will go, until the bracket is taut.
5. Attach the accessory tray to the accessory tray bracket with the three wing screws already installed in the tray. This is done by pushing the wing screws up through the holes in the accessory tray bracket, and threading them into the holes in the accessory tray.
6. Next, tighten the bolts at the tops of the tripod legs, so the legs are securely fastened to the equatorial mount. Use the provided wrench and your fingers to do this.
7. Orient the equatorial mount as it appears in Figure 2, 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 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 retighten the latitude lock t-bolt. The declination (Dec.) and right ascension (R.A.) axes may need re-positioning (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.

8. Slide the counterweight onto the counterweight shaft. Make sure the counterweight lock knob is adequately loosened to allow the counterweight shaft to pass through the hole in the counterweight.
9. Now, with the counterweight lock knob 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 knob. The retaining screw and washer on the bottom of the shaft prevent the counterweight from falling off (and onto your foot!) if the counterweight lock knob becomes loose.
10. Attach the two slow-motion cables to the R.A. and Dec. worm gear shafts of the equatorial mount by positioning the thumb screw on the end of the cable over the indented slot on the worm gear shaft and then tightening the thumb screw. We recommend that the shorter cable be used on the R.A. worm gear shaft and the longer cable on the Dec. worm gear shaft.

The equatorial mount is now fully assembled and should appear as shown in Figure 1.

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 Equatorial mount, including refractors, Newtonian reflectors, and cadadioptrics, provided a 1/4”-20 adapter or set of tube rings is available to couple the tube to the mount.

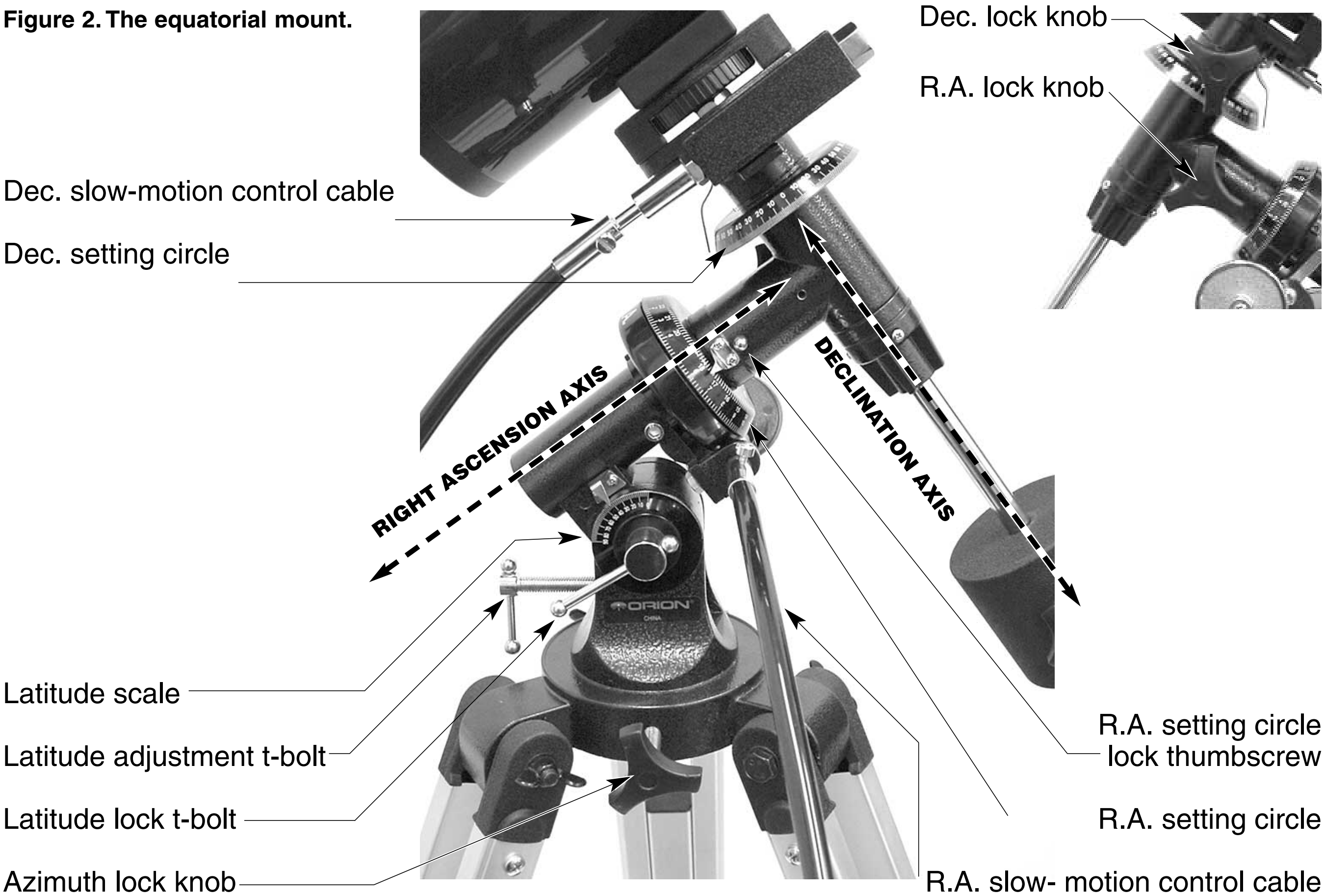
Orion carries a variety of differently sized tube rings and a 1/4"-20 mounting adapter designed exclusively for the EQ-2 Equatorial Mount. One of these items probably fits the telescope tube you wish to mount. Check the Orion print or online catalogs for currently available mounting accessories.

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

Figure 2. The equatorial mount.



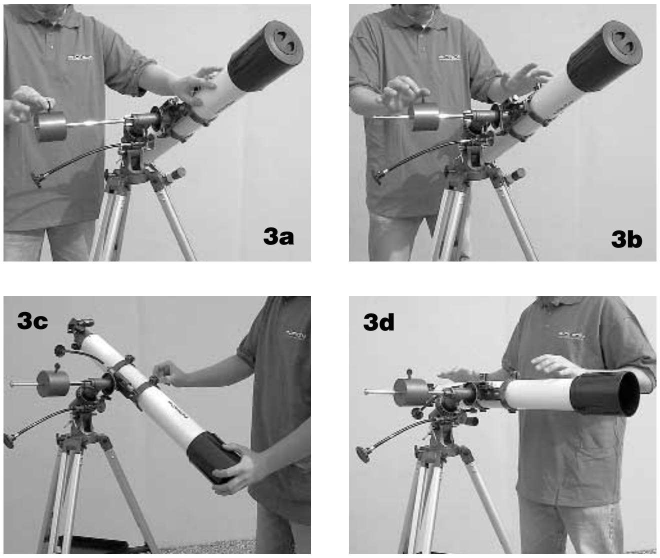


Figure 3A, 3B, 3C, 3D: Proper operation of the equatorial mount requires balancing the telescope tube on the R.A. axis. (a) With the R.A. lock knob released, slide the counterweight along the counterweight shaft until it just counterbalances the tube. (b) When you let go with both hands, the tube should not drift up or down. (c) With the Dec. lock knob released, loosen the tube ring lock clamps a few turns and slide the telescope forward or back in the tube rings. (d) When the tube is balanced about the Dec. axis, it will not move when you let go.

declination axis. This is because the telescope cannot be repositioned 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 knob and slide the weight along the shaft until it exactly counterbalances the telescope (Figure 3a). That's the point at which the shaft remains horizontal even when you let go of the telescope with both hands (Figure 3b). 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. Retighten the counterweight lock knob. 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. The telescope should now be able to rotate freely about the Dec. axis.
5. Loosen the tube ring clamps a few turns until you can slide the telescope tube forward and back inside the rings (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. This is the balance point for the Dec. axis (Figure 3d). Before clamping the rings tight again, rotate the telescope so that the eyepiece is at a convenient angle for viewing.

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 2) is designed to compensate for that motion, allowing 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 (R.A.) 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° 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 the NCP.

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.

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° 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.

Level the equatorial mount by adjusting the length of the three tripod legs.

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.

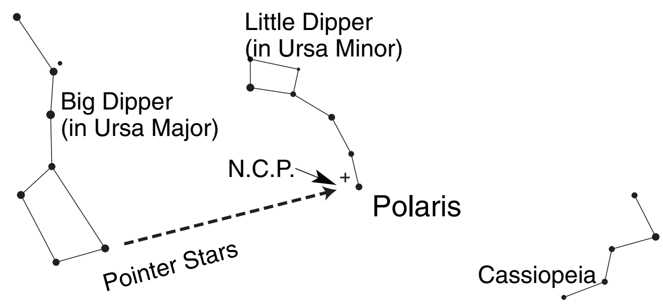


Figure 4: To find Polaris in the night sky, look north and find the Big Dipper. Extend an imaginary line from the two "Pointer Stars" in the bowl of the Big Dipper. Go about five times the distance between those stars and you'll reach Polaris, which lies within 1° of the north celestial pole (NCP).

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 lever.

Loosen the azimuth lock knob at the base of the equatorial mount and rotate the mount 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 mount so the telescope points North. Retighten the azimuth lock knob.

The equatorial mount is now polar aligned for casual observing. More precise polar alignment is recommended for astrophotography.

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 mount should be moved only about its R.A. and Dec. axes.

Use of the R.A. and Dec. Slow-Motion Control Cables

The R.A. and Dec. slow-motion control cables allow fine adjustment of the telescope's position to center objects within the field of view. Before you can use the cables, you must manually "slew" the mount to point the telescope in the vicinity of the desired target. Do this by loosening the R.A. and Dec. lock knobs and moving the telescope about the mount's R.A. and Dec. axes. Once the telescope is pointed somewhere close to the object to be viewed, retighten the mount's R.A. and Dec. lock knobs.

The object should now be visible somewhere in the telescope's finder scope. If it isn't, use the slow-motion controls to scan the surrounding area of sky. When the object is visible in the finder scope, use the slow-motion controls to center it. Now, look in the telescope's eyepiece. If the finder scope is properly aligned, the object should be visible somewhere in the field of view. Once the object is visible in the eyepiece, use the slow-motion controls to center it in the field of view.

The Dec. slow-motion control cable can move the telescope a maximum of 25°. This is because the Dec. slow-motion mechanism has a limited range of mechanical travel. (The R.A. slow-motion mechanism has no limit to its amount of travel.) If you can no longer rotate the Dec. control cable in a desired direction, you have reached the end of travel, and the slow-motion mechanism must be reset. This is done by first rotating the control cable several turns in the opposite direction from which it was originally being turned. Then, manually slew the telescope closer to the object you wish to observe (remember to first loosen the Dec. lock knob). You should now be able to use the Dec. slow-motion control cable again to fine adjust the telescope's position.

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 cable clockwise. The Dec. slow-motion control cable 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

An optional DC motor drive can be mounted on the R.A. axis of the 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 cable.

Understanding the Setting Circles

The setting circles on an equatorial mount enable you to locate celestial objects by their "celestial coordinates". Every 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.

The R.A. setting circle is scaled in hours, from 1 through 24, with small marks in between representing 10-minute increments (there are 60 minutes in 1 hour of R.A.). 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 R.A. coordinate indicator arrow is between the "R" and the "A" on the plastic R.A. gear cover (see Figure 5); ignore the metal pointer on the R.A. axis of the mount.

The Dec. setting circle is scaled in degrees, with each mark representing 1° increments. Values of Dec. coordinates range from +90° to -90°. The 0° mark indicates the celestial equator (see Figure 5). When the telescope is pointed north of the celestial equator, values of the Dec. setting circle are positive, while when the telescope is pointed south of the celestial equator, values of the Dec. setting circle are negative.

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 (there are 60 arc-minutes in 1 degree of declination).

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

Calibrating the Right Ascension Setting Circle

1. Identify a bright star in the sky near the celestial equator (Dec. = 0°) 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 whose coordinates you know. Lock the R.A. and Dec. lock knobs. Center the star in the telescope's field of view with the slow-motion control cables.
4. Loosen the R.A. setting circle lock thumb screw (see Figure 2); this will allow the setting circle to rotate freely. Rotate the setting circle until the arrow between the "R" and the "A" on the plastic gear cover indicates the R.A. coordinate listed in the star atlas for the object. Retighten the thumb screw.

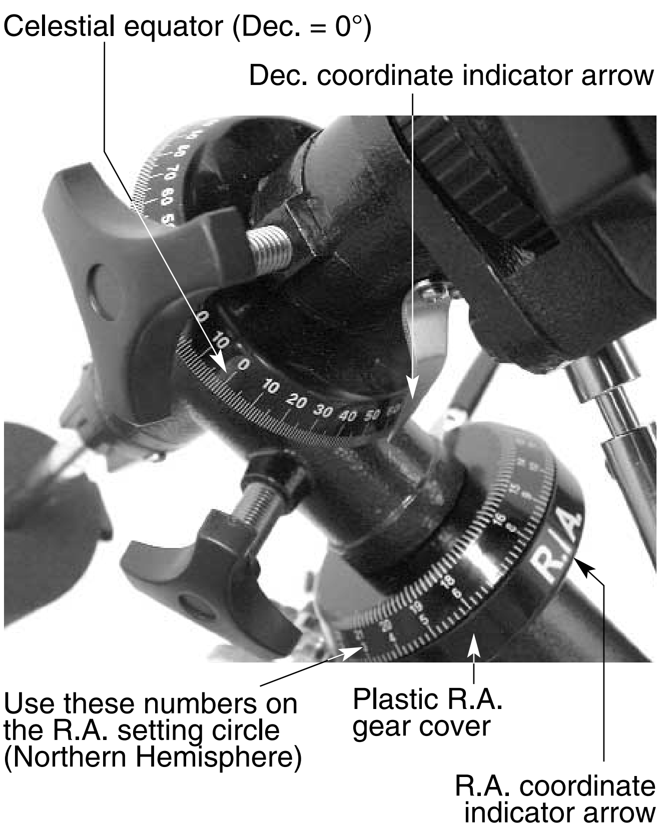


Figure 5: For Northern Hemisphere observers, use the lower set of numbers on the R.A. setting circle. The R.A. coordinate indicator arrow is between the "R" and the "A" on the plastic gear cover. The telescope (not shown) is pointing north of the celestial equator, so the approximate coordinates of the mount in the image are R.A. 8h 30m Dec. 60°.

Finding Objects With the Setting Circles

Now that both setting circles are calibrated, look up in a star atlas 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. Remember that values of the Dec. setting circle are positive when the telescope is pointing north of the celestial equator (Dec. = 0°), and negative when the telescope is pointing south of the celestial equator. Retighten the lock knob.
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. Remember to use the lower set of numbers on the R.A. setting circle. Retighten the lock knob.

Most setting circles are not accurate enough to put an object dead-center in the telescope's eyepiece, but they should place the object somewhere within the field of view of the finder scope, assuming the equatorial mount is accurately polar aligned. Use the slow-motion controls to center the object in the finder scope, and it should appear in the telescope's field of view.

Confused About Pointing the Telescope?

Beginners occasionally experience some confusion about how to point the telescope overhead or in other directions. In Figure 1 the telescope 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 nullify 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.

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 the counterweight shaft is positioned horizontally. Then rotate the scope in Dec. so it points to where you want it near the horizon.

To point the telescope to the east or west, 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.

Figure 6 illustrates how the telescope will look pointed at the four cardinal directions - north, south, east, and west

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!

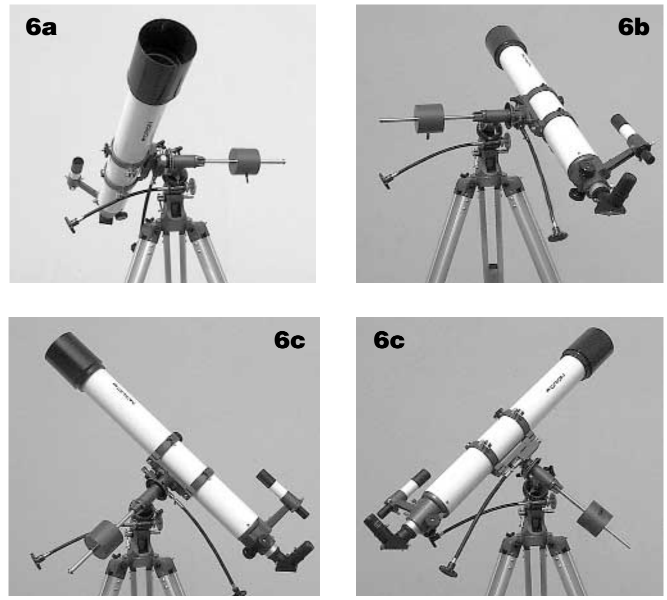


Figure 6A, 6B, 6C, 6D: This illustration shows the telescope pointed in the four cardinal directions: (a) north, (b) south, (c) east, (d) west. Note that the tripod and mount have not been moved; only the telescope tube has been moved on the R.A. and Dec. axes.

6. Specifications

Mount: German-type equatorial

Tripod: Aluminum

Height: 38” to 58”

Weight: 17 lbs

Counterweight: 5 lb. supplied

Maximum loading weight: About 10 lbs

Slow-motion adjustment: on both RA and Dec axes

Setting circles: RA scaled in 10 min. increments, Dec scaled in 1° increments, for N or S Hemisphere

Polar axis latitude adjustment: 5° to 75°

One-Year Limited Warranty

This Orion Product 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.

Orion Telescopes & Binoculars

Post Office Box 1815, Santa Cruz, CA 95061

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