# Celestial Position Lines

A celestial position line is a line as a part of the circle drawn on the earth's surface where the centre is the geographical position (GP) of the celestial body, with a radius equal to the Zenith Distance. The position line would of course be perpendicular to the bearing (Azimuth) of the celestial body from the observer. Let's suppose the ship is at O, and the celestial body X bears 254° T. The circle is drawn with radius XO, and centred at the geographical position of body X is the position circle. The arc at O that is a part of the position circle is the position line, and, of course, is perpendicular to XO, which is the bearing of the body X from the ship. This position line is just a short line, and is considered a straight line tangent to the circle at O, so this particular position line is running 164°/344°. When a position line is found, the ship's position is somewhere on it. If another position line is found, the intersection of the two position lines is the ship's position. As shown in the figure below, two intersections are made by two position circles; the bearing of the body will identify which is the corrected one.
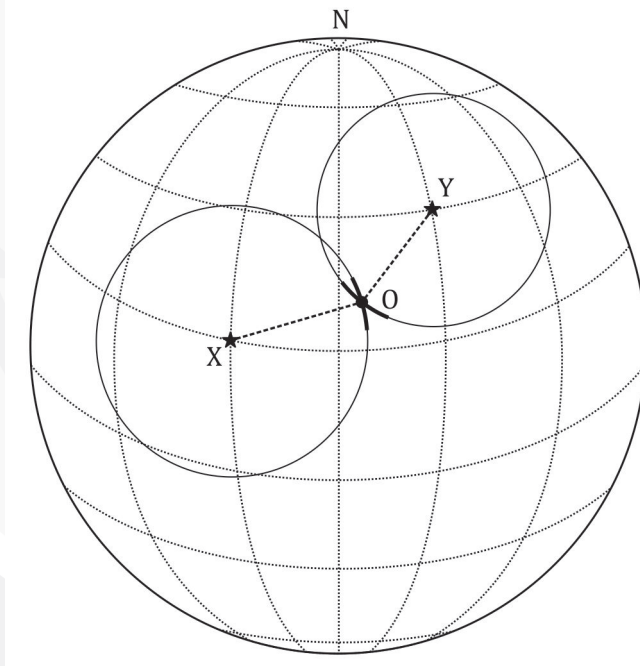
Six common methods are used to obtain the position line:

1. Latitude by Polaris (Pole Star)
2. Latitude by meridian altitude
3. Latitude by ex-meridian
4. Longitude by meridian passage of the sun
5. Longitude by chronometer
6. Intercept

Latitude by Polaris (Pole Star) — As the Pole Star is always around the North Pole at radius of 1°, so it is always on or near the meridian passage. The latitude of the observer can be determined. The position line runs in an east-west, or nearly east-west, direction.

Latitude by Meridian Altitude — This method is used to obtain the position line by taking the altitude of the celestial body when it is instantly on the same meridian as the observer's. In this case, the position line runs in an east-west direction (90°-270°), and coincides with a parallel of latitude.

Latitude by Ex-Meridian Altitude — It is sometimes not possible to obtain the altitude of the celestial body when it is on same observer's meridian due to cloud, environmental factors, etc. If the altitude of the celestial body can be obtained a few minutes before or after meridian passage, the Ex-Meridian method can be used to reduce the observed altitude to meridian altitude. The latitude of the observer can be determined. The position line runs nearly in an east-west direction.

Longitude by Meridian Passage of the Sun — By knowing that the sun orbits with one completed circle in 24 hours, or 15° for every hour, the observer can determine position at noon by using the chronometer. The advantage of this method is that the DR position is not required.

Longitude by Chronometer — This method is also used to determine the longitude of the observer. The position line runs through the position at DR latitude and observed longitude in a direction perpendicular to the azimuth of the celestial body from the observer.

Intercept — Since it is impractical to draw the large circle of a position circle on the chart, only the part of it in the vicinity of the ship that is perpendicular to the bearing of the body from the ship is drawn. When observing a celestial body, we can obtain its azimuth and altitude. The azimuth is the bearing of the body and the altitude of the body, giving us the zenith distance. As long as the altitude is corrected, the observed zenith distance is the true zenith distance, which is called *Observed Zenith Distance* or *True Zenith Distance*. With the D.R. position of the observer at the time of observing, the altitude can be calculated to obtain the zenith distance, which is called *Calculated Zenith Distance*. The difference between the observer or true zenith distance and the calculated zenith distance is the *intercept*.

If the true zenith distance is smaller than the calculated zenith distance, then the observer is nearer **toward** the geographical position of the celestial body compared with the DR position, and the intercept is called TOWARD.

If the true zenith distance is greater than calculated zenith distance, then the observer is further **away** from the geographical position of the celestial body compared with the DR position, and the intercept is called AWAY.