POLARIS 350

MANUAL

Helios

ASTRONOMISCHE UHREN

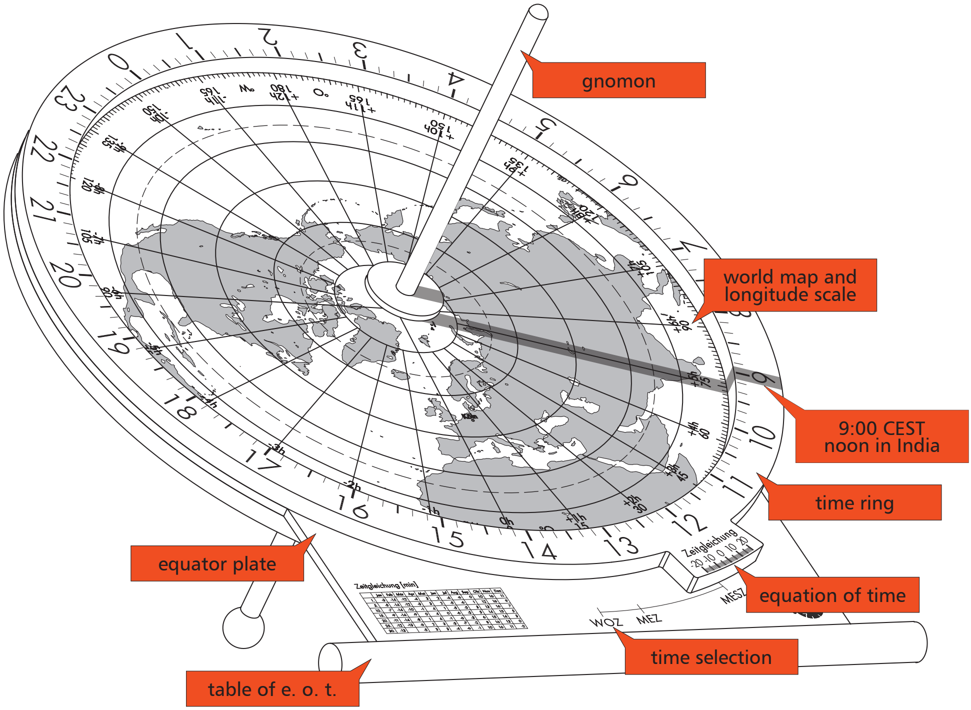

Fig. 1: The sundial POLARIS 350

The POLARIS sundial

“But it does move“ the Italian physicist, mathematician, philosopher and astronomer Galileo Galilei is supposed to have murmured, when he was forced to renounce the Copernican system at an advanced age, standing before the Spanish Inquisition.

In the meantime, Galilei has been rehabilitated by the church and today we know without a doubt that the Earth revolves around the Sun and around its own axis, which points toward the Polaris.

The POLARIS sundial has a gnomon, which stands parallel to the Earth’s axis. As the Earth revolves, the Sun seems to move around the gnomon, which illustrates the position of the Sun on the world map with its shadow.

For example, in figure 1, the POLARIS shows that the Sun is positioned above western India, so that it is noon in Bombay. Simultaneously, you can read 9:00 CEST where the shadow falls on the time ring. This is exactly the time shown on your wristwatch and not self-evident, since sundials normally display solar time.

Solar time

Solar time reproduces the natural path of the Sun at our location. It is therefore often called local apparent time (LAT). When the Sun has reached its highest point of the day (culmination), it is exactly 12:00 LAT. This point in time is local apparent noon, which effectively divides the day into two equal halves.

Even with a primitive sundial you can establish this point in time, when a stick vertically stuck into the earth casts its shortest shadow. If we monitor local apparent noon over several days using our wristwatch, we can establish that it occurs at very different times. The time from noon to noon is not always 24 hours, the solar day may be longer or shorter. During the year, the sundial may be up to 16 minutes fast and 14 minutes slow.

The reasons for the Sun’s irregular course is the Earth’s elliptic path around the Sun and the Earth’s axis, which is tilted in comparison to its cosmic path.

Local apparent time (LAT) is not a regular time measurement and is therefore not suitable for time measurement using mechanical timepieces. For this reason, an average time, local mean time (LMT) was introduced in large towns as early as the 18th century. The difference between local apparent time and local mean time is called the equation of time. Figure 2 illustrates how the equation of time changes during the course of the year.

Time zones

The invention of the railway and the telegraph during the industrial revolution of the 19th century allowed long-distance travel and worldwide communication. In particular, the need for national train timetables led to further time standardisation: the introduction of time zones via an international agreement in 1884. The time zones were positioned one hour apart, exactly the length of time required by the Sun for its migration across 15 degrees longitude of the Earth’s surface. On the POLARIS, the engraving shows the zero meridian through Greenwich in London, on which Universal Time Coordinated UTC is based, and the time zone meridians at a distance of 15° east and west.

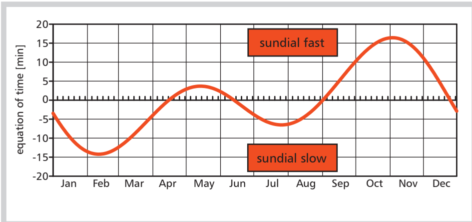

Fig. 2: Equation of time

The standard time valid for most of Europe is Central European time (CET). This is defined as the Local Mean Time (LMT) at the 15th degree of longitude east of Greenwich, on which for example the German town of Görlitz is situated. It is one hour ahead of Universal Time (UT).

Seasons

Our Earth rotates daily around its axis and migrates once around the Sun during the year. The Earth's axis is tilted vertically at an angle of 23,44° on the plane of its own orbit. During the Earth's orbit around the Sun, the direction to the Sun is constantly changing, the Earth's axis always pointing toward the celestial pole near the Polaris. This is the reason why the Sun – as viewed from Earth – appears to migrate between the tropics during its annual orbit and the seasons evolve (figure 3).

At winter solstice on December 21st, the Sun is positioned at the southern tropics, the Tropic of Capricorn. Observed from the northern half of the Earth, it is taking its lowest daily path across the horizon. On this day the whole of the northern polar zone is in darkness. At the South Pole, in contrast, the Sun never sets on this day (polar day). From this day onwards, the Sun moves upwards and follows a higher path each day, we speak of the ascending Sun.

At the beginning of spring (First Point of Aries) on March 20th to 21st, the Sun crosses the equator (declination of 0°). Day and night are of equal length. From this day onwards, the Sun does not set in the North Pole for six months, during this time the South Pole remains in darkness. On June 20th to 21st at the summer solstice, the complete northern polar zone is lit up all

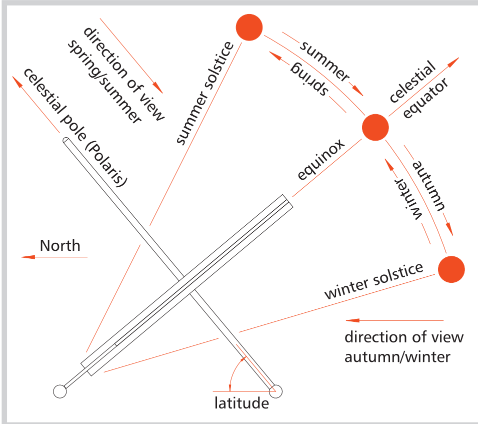

Fig. 4: Seasons

day, the Sun reaches the northern tropics (Tropic of Cancer), in the northern hemisphere it reaches its highest daily path.

From this date onwards, the Sun moves downwards and will cross the equator on 22nd to 23rd September in a southerly direction. It is now equinox again, the Sun is entering the zodiac sign of Libra and autumn is beginning in the northern hemisphere. On 21st to 22nd December, winter starts and the seasonal cycle recommences from the beginning.

Once the POLARIS sundial has been adjusted for its location, it is positioned like the Earth. The gnomon stands parallel to the Earth's axis and the equator plate with the world

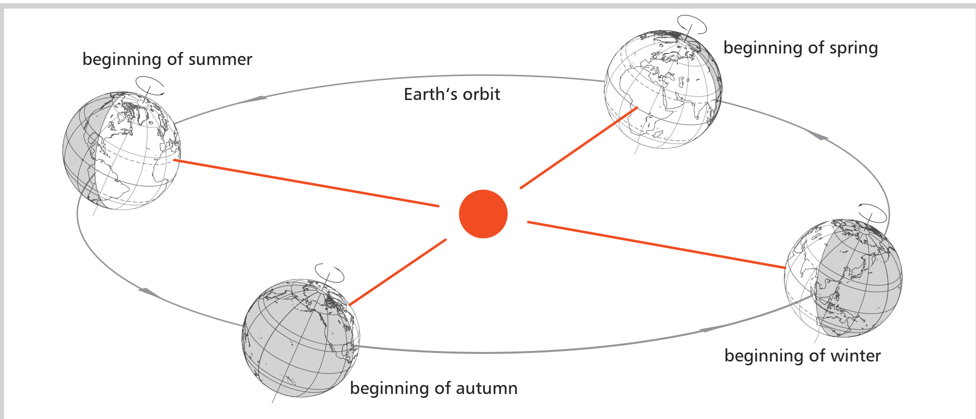

Fig. 3: Earth's migration around the Sun

map parallel to the Earth's equator level. As in real life, in spring and summer the Sun is positioned above the northern hemisphere on the world map, in winter and autumn the southern part of the world map of the POLARIS is illuminated. According to the season, the time can be read from the upper or lower part of the POLARIS. Due to its underlying design principle, the sundial does not display the time at the equinoxes (figure 4).

Setting up the sundial for its location

The POLARIS is a precision instrument, which can display the exact time and the Sun's noon position for you. The following instructions show you how to set up and adjust the sundial.

You will receive the sundial already mounted. The correct settings for the POLARIS 350 have been calculated and the sundial has been manufactured precisely for the geographic coordinates of your location. We have chosen Cologne as an example for the sundial's location. Cologne's geographic coordinates are: 51° northern latitude and 7° eastern longitude.

The gnomon's angle to the horizon corresponds with the geographic latitude. So the angle to the latitude illustrated in figure 4 is 51° in our example.

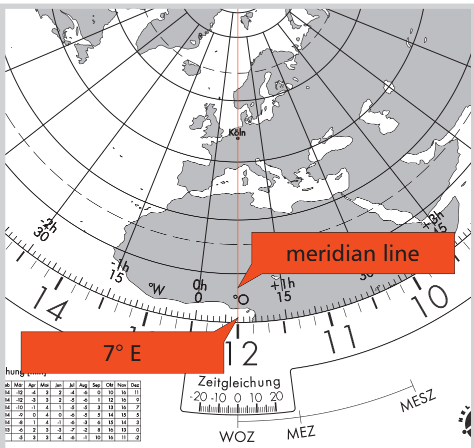

Fig 5: Meridian Line

The world maps for the northern and southern hemispheres are set up for the longitude of the intended sundial location. You can see this when you turn the time ring until 12:00 is level with local apparent time (LAT). The northern world map is turned so that your location's longitude corresponds to 12:00. In figure 5, this is 7° E, the geographic longitude for Cologne. The same is valid for the lower surface with the world map in the southern hemisphere, this is also set up for the longitude of your location.

The following description shows you how to set up and adjust the sundial.

1. Preparing the installation

A level platform is suitable for installing the sundial. This should be approximately 1 - 1.2 m above ground level, so that you can easily read the time in autumn and winter (see figure 4). The platform may be made of concrete or stone, for example. It is important that the surface on which the sundial is assembled is horizontal. You can check this with a spirit level. Small irregularities in the surface can be compensated by using the levelling screws found in the base plate.

You can install the POLARIS 350 using the rawl plugs and screws supplied. Before you start the installation, the sundial should be positioned towards the south, so that you can determine the securing points.

2. Determining the southerly direction

The Central European Time can be read from the POLARIS 350, so that you can immediately compare this to the time on your watch. You can also set up the POLARIS by using the time on your wrist watch, so that it is automatically adjusted to the South.

First you just need to set the equation of time, which is dependent on the date. In our example we assume it is May 15th. For this date, a value of +4 min for the equation of time can be read off the table, which you will find on the left side of the equator plate. Set the equation of time by turning the time ring, until +4 on the equation of time scale is set at CEST for Central European Summer Time (fig 6).

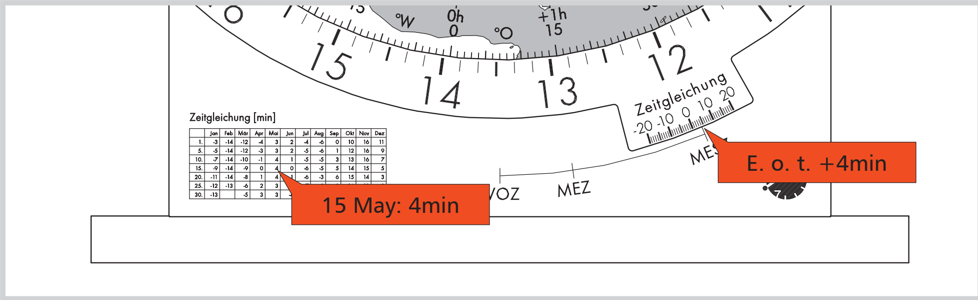

Fig. 6: Setting the equation of time

Now everything is ready for the adjustment to the south. Set the POLARIS up at the desired location. Now turn the sundial until the gnomon's shadow shows the same time as that on your watch (figure 9). In spring and summer from 20th/21st March until 22nd/23rd September you can read the time from the northern side (upper face), in autumn and winter from the southern side (lower face) (figure 4). As soon as the POLARIS' time corresponds with the time on the watch, the sundial is adjusted to the south.

3. Installing and adjusting the sundial

Now mark the positions of the boreholes and slots provided for securing purposes in the base plate. Remove the sundial and drill boreholes of at least 55 mm at the positions marked using a drill suitable for the surface you have chosen. Insert rawlplugs into the boreholes. The threaded bolts are fitted with two counter-nuts so that you can screw them in. To fit the counter-nuts first screw in the nuts one after the other on to the bolt, so that they close off the top flush with the end of the threaded bolt. Now hold the lower nut with one spanner wrench and using the other, tighten the top nut against the lower one. We have already fitted the counter-nuts to one of the threaded bolts. Now screw the threaded bolt into the rawl plug, so that it still sticks out approximately 13 mm from the surface. Then release the counter-nuts with the two spanner wrenches in the same manner in which you tightened them, except this time, just loosen the top nut. Insert the other two threaded bolts in the same way.

Now place the sundial on the threaded bolts. Level out the base plate using the spirit level and the three adjusting screws. To do this, place the spirit level on the base plate, alternating between lengthwise and crosswise and turn the adjusting screws to level out the position.

The cap nuts with washers are screwed on loosely. Before you finally tighten the screws, check the time displayed on the sundial. If this is not exactly the same as the time on your wrist watch, turn the base plate until the time is correct. Then tighten the nuts.

Reading from the sundial

After you have set up the POLARIS 350, the gnomon points to the celestial pole near the Polaris (Polar star). The sun appears to move around the gnomon and you can read off the time and the sun's noon position all day as long as the sun is shining. The sundial's time ring can be rotated, enabling you to display the normal wrist watch time (CET/CEST) as well as local apparent time (LAT).

In spring and summer, you can read time on the sundial from the northern side (upper face), in autumn and winter from the southern side (lower face). At the beginning of spring (20th/21st March) and beginning of autumn (22nd/23rd September) and for a few days before and after these dates, the sundial will not display the time at all or only indistinctly. However, if you hold a piece of paper at the outer side of the time ring and catch the shadow, you may be able to read the time.

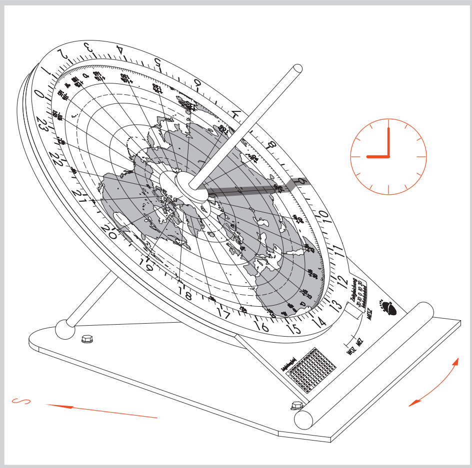

Fig. 7: Adjusting towards the south

Central European Time and Central European Summer Time

Central European Time is the standard time valid for Germany and many other European countries. On the POLARIS 350 world map, the time zone meridian for CET is marked at the 15° longitude east of Greenwich. If you set the time ring with the "0" for the equation of time at CET, then 12:00 will be positioned correctly at the 15° E meridian. For four days of the year – when the equation of time equals zero – the sundial will also display 12:00 CET when the sun is positioned at 15° E meridian. On all other days, it will display an earlier (equation of time > 0) or a later time (equation of time < 0) at this location. You can read the value for the equation of time from the table on the equator plate and use this value to set the scale correctly. Now you can read Central European time directly in the middle of the gnomon's shadow.

During the summer time, you can use the CEST mark to set the equation of time.

Local apparent time – solar time

Needless to say, you can also set local apparent time (LAT) on the POLARIS for your location. LAT is determined directly by the Sun. It is 12:00 LAT when the Sun reaches its highest point (culmination) at noon and passes the local meridian (meridian line). The shadow then falls exactly on the longitude at which the installed position is located. This means that we turn the time ring until the „0" on the equation of time scale is positioned at LAT (see fig 5). It stays here for the whole year to display LAT, a date-dependent setting similar to the equation of time does not exist for this case. The POLARIS always shows solar time directly.

The Sun's migration around the world

Just as at your own location, noon occurs at every location on Earth. This event takes place at the longitude at which you can see the shadow line on the POLARIS world map at this moment in time. At all other locations on this longitudinal line, the Sun is currently reaching its daily culmination. In the northern hemisphere it is then exactly at the south, on the southern hemisphere in the north. In the tropical zone between the tropics, the Sun – depending on the season – appears from one of either directions and on two days in the year reaches its zenith.

In our example on 15th May at 9:00 CEST (figure 1 and 7), the Sun is 74° east of Greenwich over western India at noon. If you were to find yourself 120 km east of Bombay at this moment in time, the Sun would just be culminating in the south.

Support

If you have questions on the installation and use of your sundial, you can reach us at the following address:

HELIOS (EK)
Begasweg 3
D - 65195 Wiesbaden
Phone: +49 - (0)611 - 18 51 106
Fax: +49 - (0)611 - 59 83 29
Email: email@helios-sundials.com
Homepage: www.helios-sundials.com

We are always grateful for comments and suggestions.

We wish you much enjoyment with your POLARIS 350 on many sunny days.