



Sundials

A **Sundial** is an instrument which measures time by casting a shadow from the Sun. The position of the shadow is dependent on the location of the Sun as it moves through the Ecliptic (the arc of the East / West passage taken by the Sun across the sky).

The most common type of Sundial is a Horizontal Sundial. This consists of a horizontal plate, marked with hours of the day, and a gnomon (either a vertical plate with a linear, sloped edge - or an angled rod) mounted on the horizontal plate. The sloped edge of the gnomon is called a style.



The Sun casts a shadow from the style onto the horizontal plate. As the Sun moves through the Ecliptic, this shadow lines up with consecutive hour markings on the plate.



An alternative to the Horizontal Sundial is a Vertical Sundial. This functions in much the same way as a Horizontal Sundial except the plate is mounted vertically. This type of Sundial is orientated with the surface of the plate positioned so that it is facing in the direction of the Sun at its maximum elevation (Solar Noon).

Yet another type of Sundial is an Equatorial Sundial. With this type of Sundial, the gnomon is usually a thin rod. In its simplest form, an Equatorial Sundial incorporates a round, flat plate which is marked with hours of the day. Instead of positioning the plate horizontally or vertically, it is positioned so that it is oriented in a plane parallel to the Equatorial Plane (picture a plane passing through the Earth at the equator). The gnomon is positioned in the middle of the plate, protruding at a right angle from the plate.



A variation on the Equatorial Sundial is an Armillary Sundial. This type of Sundial looks a little like a skeletal sphere, with an arrow passing through it. The shaft of the arrow shaped gnomon casts a shadow on the calibrated "Equatorial" Arc. The Equatorial Arc is so called since it is set up to be parallel to the Earth's Equatorial Plane.

For any of the above Sundials to function properly their gnomons must be aligned with the Earth's axis of rotation. Consequently, the gnomon must be:

- ★ Aligned along a line of longitude - i.e. aligned true North / South (not magnetic North / South), and
- ★ The angle of the style, with respect to horizontal, must be equal to the angle of latitude at the location where the Sundial is installed.

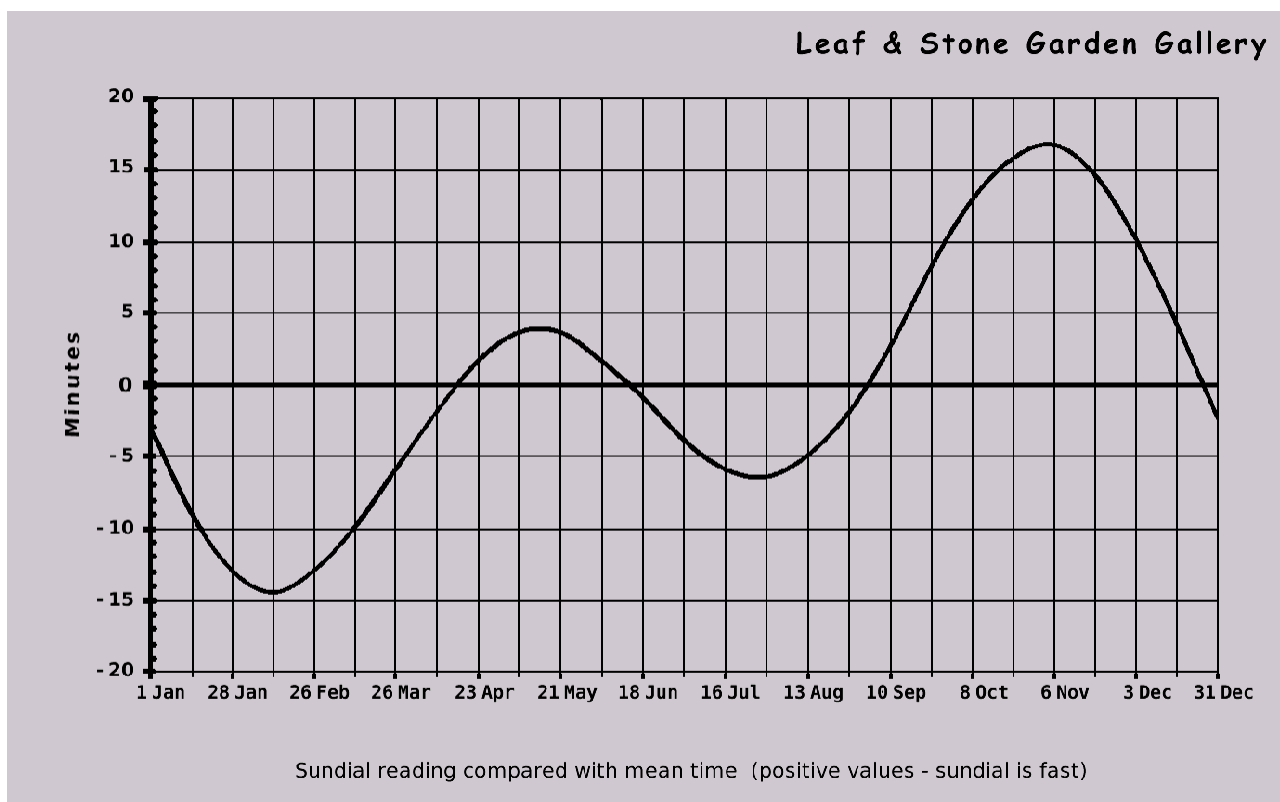
Under these circumstances, the gnomon is oriented in such a way that the Sun is positioned at a constant angle to its style throughout the day. At the equinoxes this angle is 90 degrees and it varies by +/- 23.4 degrees over the course of the year.

For example, with a horizontal sundial, the point where the style makes contact with the plate is directed towards the Sun at Solar Noon. Consequently, in the Southern Hemisphere, it is directed to the North. In the Northern Hemisphere it is directed to the South. This difference between Hemispheres means that a Southern Hemisphere Sundial reads "backwards" - in the Southern Hemisphere, the time on a Sundial is read from right to left (i.e. 1:00 pm is marked to the left of 12:00 Noon).



Solar time differs from “Clock” Time. The Earth’s rotation is not in the same plane as its orbit around the Sun, and this orbit is not perfectly circular but slightly elliptical. These two factors combine to produce a slight “wobble” in the time read from a Sundial over the course of a year. Adjustments must be made to the time read from a Sundial to get the correct time. The equation used to calculate this difference is known as the “Equation of Time” and the graph below shows the variations to be taken into account.

Equation of Time:



Other factors to consider:

The difference between true Solar Noon (when the Sun is at its maximum elevation) and Noon according to our clocks, depends upon our Longitudinal position on the ground. Subtract 4 minutes from the time read on a clock for each degree of Longitude West of the “Noon Meridian” (the Sun’s Longitude at 12:00 Noon clock time). Add 4 minutes per degree if your location is East of the Noon Meridian.

Example: In Eastern Australia, at 12:00 Noon clock time, the Sun is (nominally) at position 150 Degrees East Longitude. This means it is located 5 degrees to the East of Melbourne (which is at 145 deg. East Longitude). It does not reach its maximum elevation at Melbourne until approximately 12:20 according to our clocks (+/- the correction for time of year given by the Equation of Time).

An extra one hour difference needs to be included during *Daylight Saving Time*.