

Feb 24, 2008

THE OLD HOUSEWIFE'S TRICK

How do you adjust a sundial for the longitude difference, how do you adjust it for the equation of time, EOT.

A number of books talk of the old housewife's trick of rotating the sundial until it shows the correct time.

First, the correct way to do things. Atkinson's Theorem says that you may rotate an hour angle sundial around its style to effect a shift in time. This works.

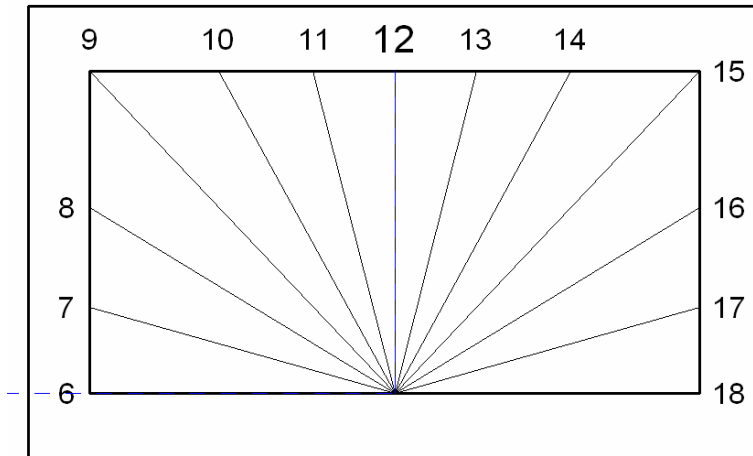
However, this should not be confused with what to do when a sundial is designed for a different latitude, when it is tilted to the north or south until the style now is set at latitude for the current location.

But what about rotating the plate.

For an equatorial dial (one that is a vertical non decliner on the equator), or an armillary dial, the hour line angles are 15 degrees apart and thus, being linear, may be rotated to effect a linear change of time. This may correct for longitude differences from the legal time meridian, and if done regularly, such as every 10 days, can also adjust for the equation of time. The rotation is done around the style.

The old housewife's, or is it wives, trick does not do that, it rotates the dial as it rests horizontally.

Below is a horizontal dial for the north pole, latitude 90 degrees.



Here, a horizontal dial on the north or south pole has hour line angles of 15 degrees. Think about it, a plate on the pole is an azimuth dial

Hour and hour line angle H-DIAL

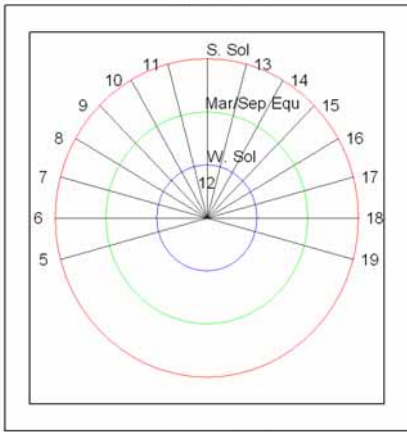
6	7	8	9	10	11	12	13	14	15	16	17	18
-90.0	-75.0	-60.0	-45.0	-30.0	-15.0	00.0	15.0	30.0	45.0	60.0	75.0	-90.0

Hours below horizontal use the 90 reference line below horizontal.

Lat: 90.0 Long: 105.0

Here is an azimuth dial for the pole, it is the same as a horizontal dial. The learning from this is that an azimuth dial uses one component of an hour angle dial. Similarly with an altitude dial. Or, another learning is that an hour angle is made up of the altitude and azimuth components.

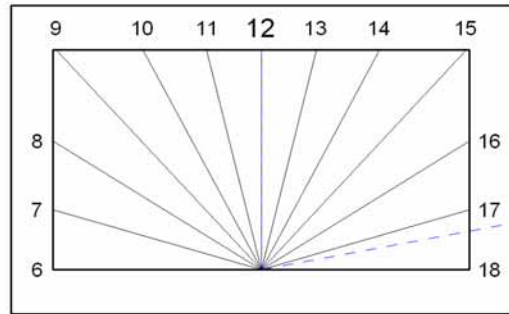
Z-DIAL Lat: 90 Long: 105 ref: 105



Assumes spline=azi/decl as approx

So, at the north pole, rotating a horizontal dial can be used to correct for longitude differences from the legal time meridian, or, if done frequently, such as every 10 days, can also be used to correct for the sun's variation, called the equation of time, or EOT.

At latitude 80 this works well.



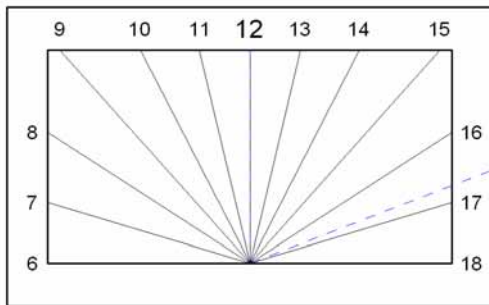
Hour and hour line angle H-DIAL

6	7	8	9	10	11	12	13	14	15	16	17	18
-90.0	-74.8	-59.6	-44.6	-29.6	-14.8	00.0	14.8	29.6	44.6	59.6	74.8	-90.0

Hours below horizontal use the 90 reference line below horizontal.

Lat: 80.0 Long: 105.0

At latitude 70 it still is usable.



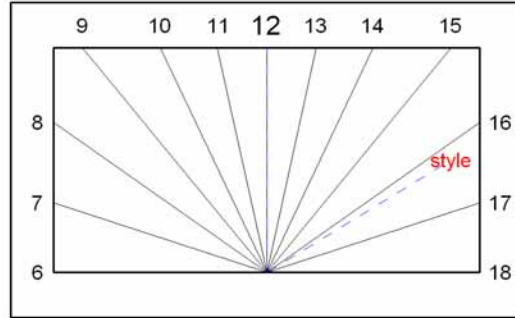
Hour and hour line angle H-DIAL

6	7	8	9	10	11	12	13	14	15	16	17	18
-90.0	-74.1	-58.4	-43.2	-28.5	-14.1	00.0	14.1	28.5	43.2	58.4	74.1	-90.0

Hours below horizontal use the 90 reference line below horizontal.

Lat: 70.0 Long: 105.0

At latitude 60, the hour lines angles and clearly not linear, but the trick is close enough.



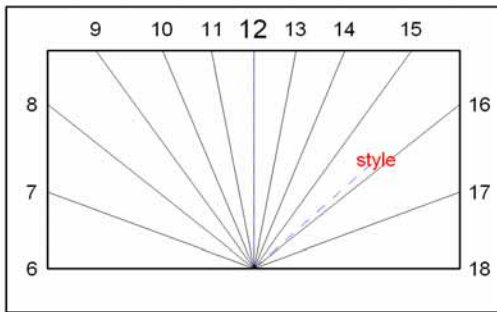
Hour and hour line angle H-DIAL

6	7	8	9	10	11	12	13	14	15	16	17	18
-90.0	-72.8	-56.3	-40.9	-26.6	-13.1	00.0	13.1	26.6	40.9	56.3	72.8	-90.0

Hours below horizontal use the 90 reference line below horizontal.

Lat: 60.0 Long: 105.0

At latitude 50 the angles become less usable.

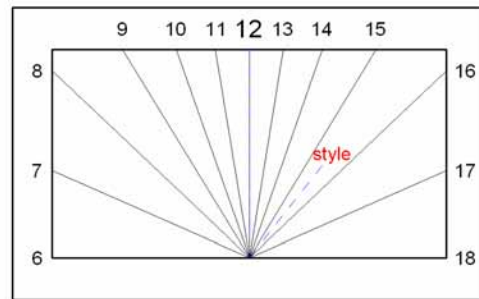


Hour and hour line angle H-DIAL

6	7	8	9	10	11	12	13	14	15	16	17	18
-90.0	-70.7	-53.0	-37.5	-23.9	-11.6	00.0	11.6	23.9	37.5	53.0	70.7	-90.0

Hours below horizontal use the 90 reference line below horizontal.

Lat: 50.0 Long: 105.0



Hour and hour line angle H-DIAL

6	7	8	9	10	11	12	13	14	15	16	17	18
-90.0	-67.4	-48.1	-32.7	-20.4	-9.8	00.0	9.8	20.4	32.7	48.1	67.4	-90.0

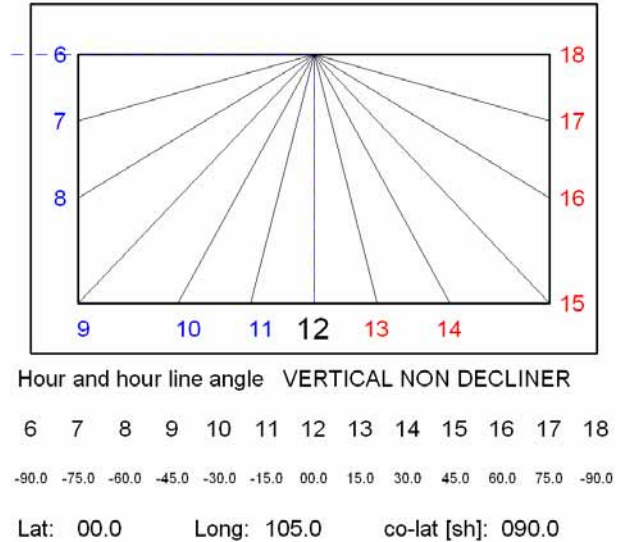
Hours below horizontal use the 90 reference line below horizontal.

Lat: 40.0 Long: 105.0

At latitude 40 the system breaks down.

And of course, at the equator, the horizontal dial is a polar dial because its dial plate parallels the polar axis.

However, a vertical dial at the equator, has 15 degree hour line angles, but that is not of interest to us here.



SUMMARY

The old housewife's trick of turning a horizontal dial horizontally works perfectly at the pole, and work fairly well down to latitudes of about 50 degrees or a bit closer to the pole. This is true for the south hemisphere also.

WHAT THE OLD HOUSEWIFE'S TRICK CAN CORRECT FOR

You can correct for longitude.

You can do regular corrections for the equation of time.

WHAT YOU CANNOT CORRECT FOR USING THIS TRICK

A dial plate designed for a different latitude can be corrected by tilting to the pole or equator, see the document: www-reverse-engineering.pdf

And you can use the spreadsheets also to determine the design latitude for an unknown dial:-

a0.0 unknown dial.xls	[in the PDA Excel section]
reference-unknown-dial.xls	[in the normal Excel section]
illustrating-shadows.xls	[or preferably this sheet]

PICTORIALLY

Below is the planet Earth, there is a horizontal dial at the pole, a vertical (by definition) at the equator.

Imagine the movement of the dial south from the pole to the lower latitudes, and unless tilted, there would still be a 15 degrees per hour, hour line angle. Moving to lower latitudes, a horizontal dial would be parallel to the surface, and thus tilted from where it was at the pole. As lower latitudes are reached, that tilting which keeps the dial plate horizontal with the planet's surface, causes the hour lines to depart from 15 degrees per hour, As that happens, the old housewife's trick no longer works.

