

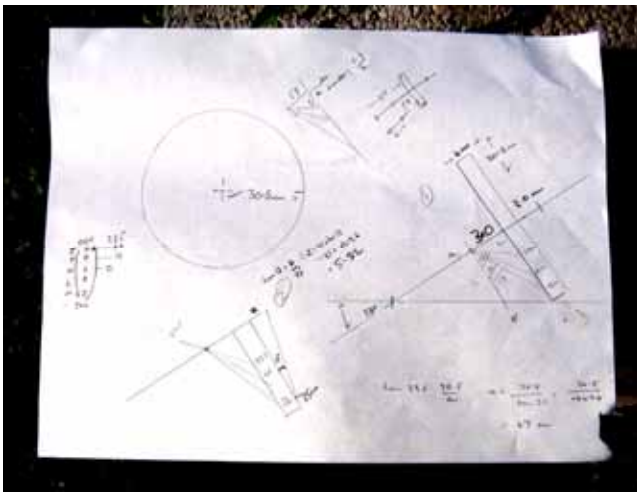
CASE STUDY ~ AN EQUATORIAL DIAL WITH CALENDAR CIRCLES

This dial will be for Silver City, NM, whose coordinates are:

location lat: 32.75° N
 location long: 108.2° W
 magnetic declination: 10.6° E

A concrete paver from a garden supply shop was acquired and a hole drilled in dead center with a masonry bit. Into that hole was inserted a threaded rod as the gnomon, its length was cut to be 5 cm on each side, and the paver itself was 4 cm thick, making a total length of 14 cm.

From that center were drawn 15 degree radials for the hours, and since this dial would be longitude corrected, another mark was drawn 3.2 degrees offset from noon, and when installed, that offset mark would be the vertical.



Then the sun's declination was established for the calendar lines.

	Dec solstice	-23.5
Jan	Nov	-20
Feb	Oct	-12
Mar	Sep	0
Apr	Aug	+12
May	Jly	+20
	Jun solstice	+23.5

Given the sun's declination angle and the height of the gnomon, the distance for the calendar circle was established, and the appendices have it tabulated or the formula can be used:-

$$\text{calendar circle radius} = \frac{\text{gnomon linear height}}{\tan(\text{declination})}$$

The design notes were all of one page, and the only geometric or trigonometric work was limited to:-

- how long the gnomon was to be in order to have reasonable calendar circles
- what is the radius of those circles

The radials and the calendar circles appear on the upper (summer) side as well as the lower (winter) side. They were first scribed with a Dremel engraver. The hour lines were scribed against a straight edge, the calendar lines were scribed using a 1/4 piece of wood with some holes in it to act as a rotating rule. One hole fitted over the gnomon, the other two were set to the calendar circle radius and were large enough to accommodate the Dremel engraver but with no slack. The wooden radial rule was rotated, and all lines were engraved well. Then a Dremel rotary tool was used with the masonry circular disks to refine those lines.



While little dust may be thrown up by the engraver, there is still some. And the rotary cutter will clearly create clouds of the stuff. There is a health risk of silicosis, thus this operation should be well ventilated or outside, and a tight, not loose, fitting face mask should be worn, as well as eye protection. The clothes will become saturated with dust as well.

To the right is shown the brick support mechanism, it limits winter hours somewhat, but not excessively.



The picture to the left shows the solstice circle and one month after that. Two months after that was in fact the periphery of the paver. The third month after was the equinox and that radius is of infinite size.

The backing of the dial, the winter side, was supported by clay bricks cut with a masonry saw at co-latitude, so the paver paralleled the equator and the rod paralleled the polar axis.

Two holes were drilled in the paver and in the bricks into which rods were inserted to add stability. One hole was coincidentally on an hour line, the other was not, this was because the dial plate was rotated to correct for the dial's longitude difference from the legal time meridian.

The final touches were to mortar the entire dial in place. This dial was placed on one of the columns of the analemmatic dial. This dial took one day from start to finish, and if 1/4 inch copper tube was used in place of the threaded bolt, the entire dial would look rustic and a wonderful addition to a country garden.

To the right is the equatorial dial in place on the 6 am column of the analemmatic dial.

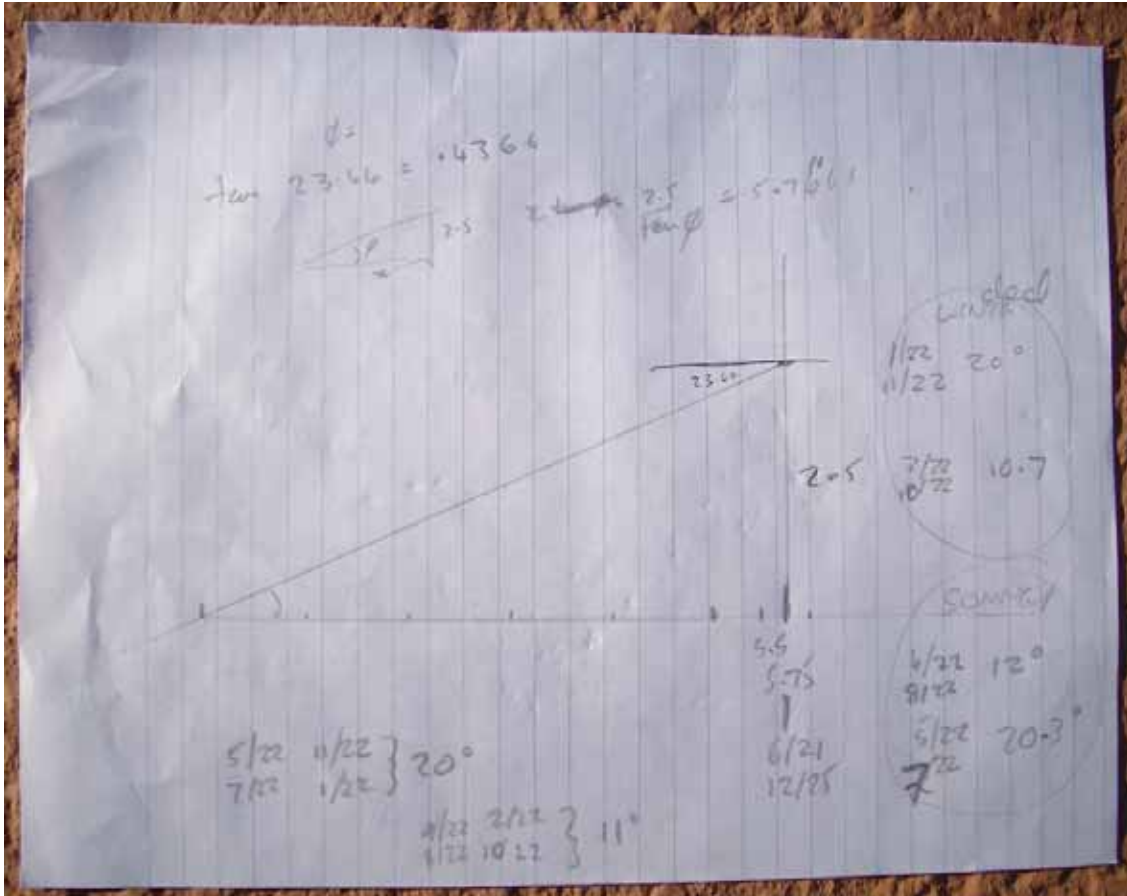
Note: Calendar or declination lines and curves are discussed in chapter 23, with other lines discussed in chapter 24, and analemmas in chapter 25.



PHOENIX latitude 33.5 longitude 112.1 and legal meridian of 105

The DeltaCAD macro can draft a plate for you for the upper and lower dial plates, and the main spreadsheet also has a section just for equatorial dials.

11, 20, 23.44 degree declinations for dates



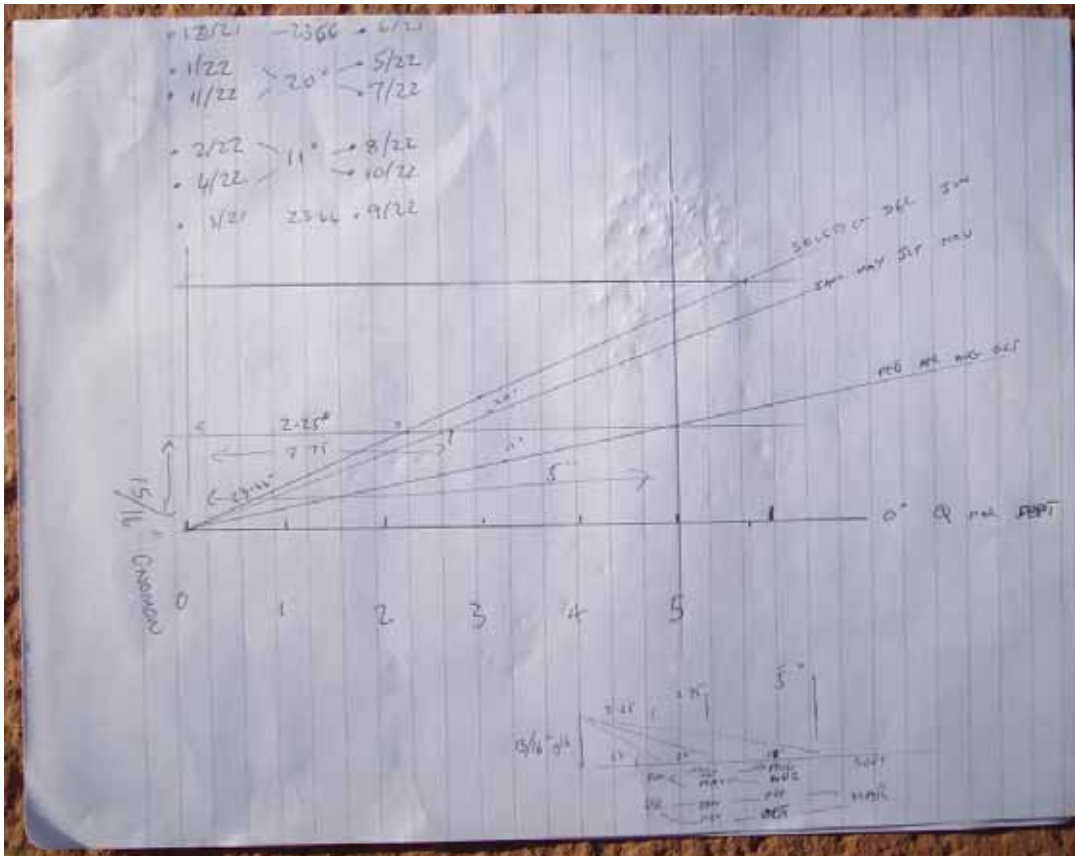
Jan 22	Feb 22	Mar 21	Apr	May	Jun 21
20	11	0	11	10	23.44
Jly 22	Aug 22	Sep 21	Oct 22	Nov 22	Dec 21

For an equatorial dial, the equinox nodus shadow is at infinity. A 1" gnomon was used, so the distanced were:-

$$\tan(\text{decl}) = 1'' / \text{radius}$$

thus $\text{radius} = 1'' / \tan(\text{decl})$

A 6 inch radius paver was used (one foot diameter), so 5" was a good distance for one month before and after the equinox, and that suggested a 1 inch gnomon linear height.



Gnomon height	1.00
calendar data:	decl
June solstice	23.44
May and July	20.00
August and April	12.00
Marh/Sept equinox	0.00
October and February	-12.00
November and January	-20.00
December solstice	-23.44

dist from base of gnomon

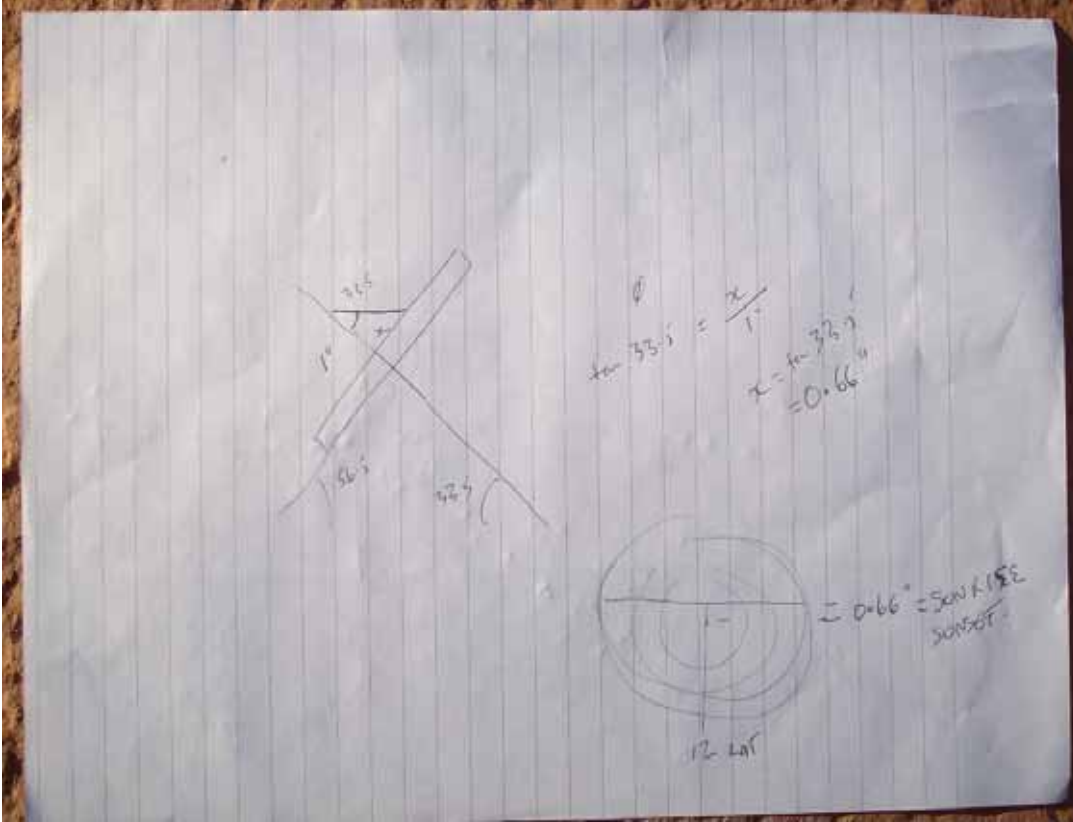
2.306
2.747
4.705
way way far away
-4.705
-2.747
-2.306

gnomon / tan(decl)

The distance above (summer) and below (winter) of the sunrise/set line is:-

$$\tan(\text{lat}) = \text{dist} / \text{gnomon}$$

thus $\text{dist} = \text{gnomon} * \tan(\text{lat})$



latitude 33.50

sunrise/set distance from base of gnomon

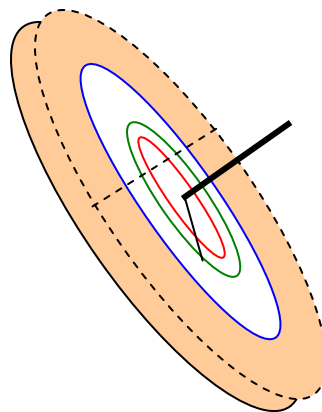
0.662 -----

longitude 112.20

legal meridian 105.00

rotation of hour lines 7.20

in degrees away from legal meridian



Equatorial dials are named because the dial plate parallels the equator.

All hour lines are 15 degrees apart.

See chapter 9 of Illustrating Time's Shadow

See also DeltaCAD macro: [MAIN-q-dial.bas](#)



Line and circle engraving was done with a normal diamond blade rotary saw lying around the house, used for cutting pipes and the line.

This picture was taken on the fall equinox, so the nodus shadow is at infinity.



September 2011
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