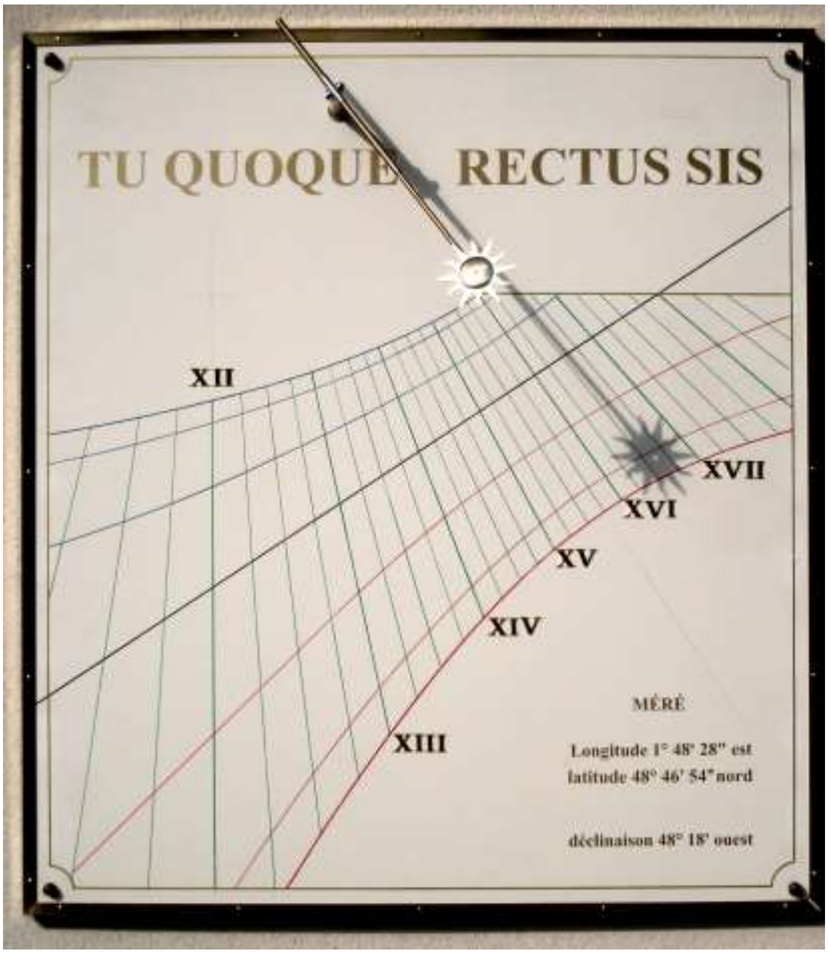
CREATION OF A SUNDIAL AT MÉRÉ
WITH THE SHADOWS SOFTWARE

This document describes the creation of a sundial using data calculated by the Shadows software, and shows the practical steps until the sundial is finished and installed. The design and realization were made by **Michel Lambalieu**. Thanks a lot to hom for sharing his experience with the community of Shadows users.

The Shadows software can be downloaded on www.shadowspro.com. Its user manual can be found on-line on www.shadowspro.com/manual.

Vertical declining sundials are among the most beautiful due to their particular layout, but fixing their style is frequently the main difficulty for an amateur who is not equipped with the correct tools..

« *I assigned myself the objective to create and realize a sundial using only materials and parts easily available from retail stores, and yet providing a very good accuracy around one minute. I think that I finally found an acceptable solution and I share my tips here to encourage others to start their own sundial.* » Michel Lambalieu



Michel's sundial is installed at Méré, in the suburbs of Paris.

Latitude 48° 46' 54'' North,

Longitude 1° 48' 28'' East.

Its size is 90 cm x 100 cm ; it declines by 48°18' towards West.

A mockup of this sundial was done in a special wood that can resist to outside humidity, reinforced by metal rods and then coated with a protective layer before being painted using a special outdoor paint. All parts and materials have been bought in retail stores.

The final realization (here on the left) was done on stratified support.

The Latin motto: TU QUOQUE, RECTUS SIS means *You too, be just*. It underlines the accuracy of the sundial and provides a second level of meaning for the reader.

DETERMINATION OF THE WALL DECLINATION

The determination of the wall declination is the start of many sundial projects, and is key for its accuracy. One of the possible methods makes use of a protractor and a plumb line.

Realization of a protractor

A protractor of large size is required to ensure accuracy. It can be printed from Shadows on a large sheet of paper and stuck on wood and cut. The drawing of a protractor can be found in the **Display** menu > **Drawing tools**. The size can be defined from the **Configuration** menu.

A school protractor may also be OK, especially some models have a diameter of more than 30 cm. Make sure that the flat edge is aligned on the marks 0° and 180°, as shown on the photo.

You may need to change the scaling as 0° shall be perpendicular to the wall, instead of 90°, or do not forget to do the maths when you measure the angle. Angles are counted negatively towards East and positively towards West.

During the measurement, ensure the tools is perfectly horizontal using a spirit level, and you can even use two of them, aligned on the X and Y axes.

Installation of the plumb line

Choosing a proper plumb line is not so obvious… the shadow penumbra and sometimes interference patterns make it difficult to identify the correct position, when the thread is too thin.

The solution used here was to use a thick line that casts a shadow of several millimeters, and the center of that shadow was taken into account, which seemed easier in practice.

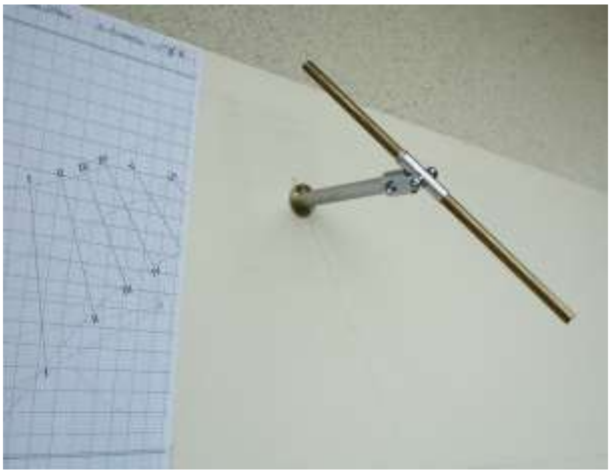
Several methods of measurement have been tested. They are described in the Shadows user manual.

It is necessary to avoid movements due to wind during measurements, so the weight of the plumb line is plunged into a bucket of water. The table where the measure was marked was made of a wood board installed on two trestles, and adjusted to be perfectly horizontal.

The measured angles can be compared with the **Instant ephemeris** in Shadows that provide Azimuth of the Sun for a given instant.

Shadows Expert also offers a special tool, **Calculate the declination of a wall**, that does all the calculations from the raw measurements made on the field.

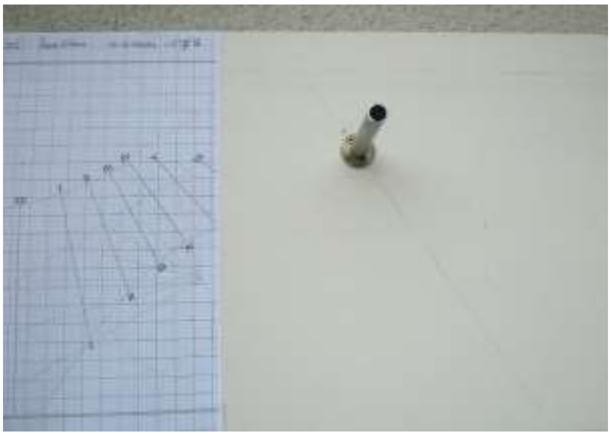
Realization and installation of the style



With the Shadows software, the position of the style is defined by points A and B. In this case, the polar style is truncated. Point A corresponds to the perpendicular style; Point B corresponds to the intersection of the polar style with the sundial table, but here it is too far from the sundial center due to the wall declination.

The style is made of a rod holding the eyepiece, which increases the contrast between shadow and light and makes it easier to read time.

The eyepiece is placed just above Point A, perpendicularly to the sundial plate. The leg supporting the style is attached on the substyle line (the line joining points A and B).



The leg is fixed using an electrical socket in brass with two holes for the screws.

An aluminum tube is attached to the threaded part of the socket. Its length is 1 centimeter shorter than the expected length to allow a precise adjustment in height. Then the components are secured together using epoxy cement after having checked that the leg is perfectly perpendicular to the tube.

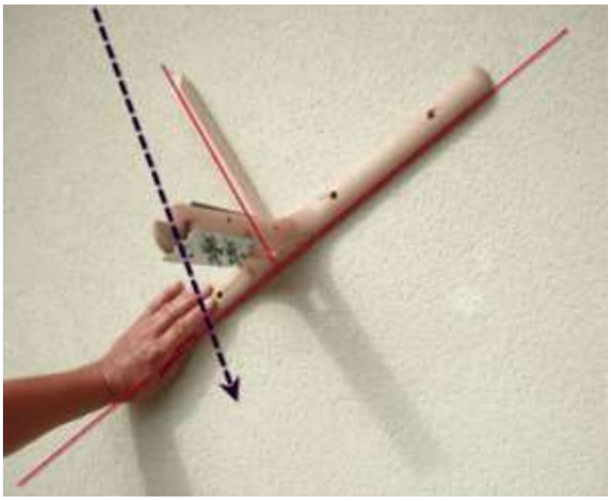
A cardan shaft used for operate sliding blinds is used to attach the polar style to the leg.

The leg is an aluminum tube; available materials are not always found at the expected dimension, so it is necessary to cut and adjust them.

The leg is drilled and threaded, then fixed to the cardan shaft.

The orientation and reclination of the style are key for the accuracy of the sundial. Deviations sometimes observed on sundials are more often due to a defective style rather than the drawing of the layout.

Shadows provides a patron for the style, to scale, that will be used to align and orient the style above the substyle line.



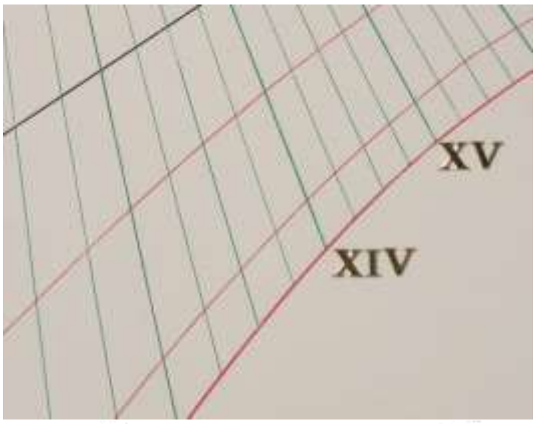
We build a triple square in order to ensure perpendicularity of the leg with the wall. The end of the tube, off the wall is cut in V to ensure a firm positioning of the polar style.

The material used here is:

- 2 squares in wood, about 30 cm long. Holes allow a temporary fixture on the wall ;
- 1 wooden strip of 16 mm thickness and 30 cm long ;
- 2 metal plates;
- 2 threaded rods of 3 to 4 mm diameter with winged nuts.

The eyepiece is build from a curtain tieback medallion bought in a DIY store. It conveniently represents the Sun. The curtain loop is removed and a hole is drilled to allow the light spot.

A rod is then soldered to the medallion using tin solder paste, and the alignment is carefully checked.



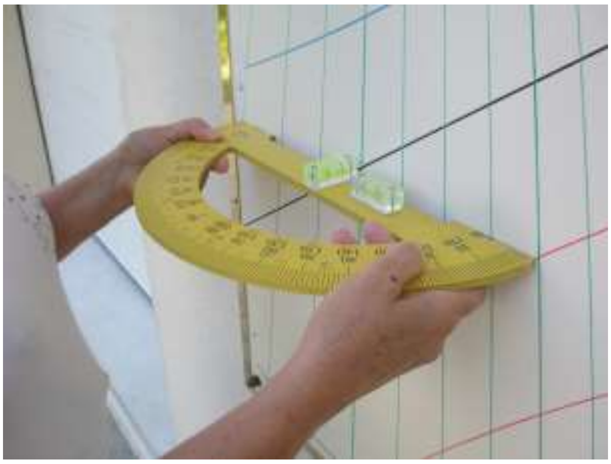
French curves

Now we can draw the layout

Hour lines and declination arcs are drawn point by point using a printout made with Shadows. Points are then connected with lines drawn with a *French curve* using a permanent marker. A French curve is a plastic or metal tool that provide various curvatures. It is also possible to use a spline ruler that can be curved to follow the path of points. These tools can be found in arts and crafts stores.

A key provides latitude, longitude and wall declination of the sundial. It is realized using a stencil and paint spray.

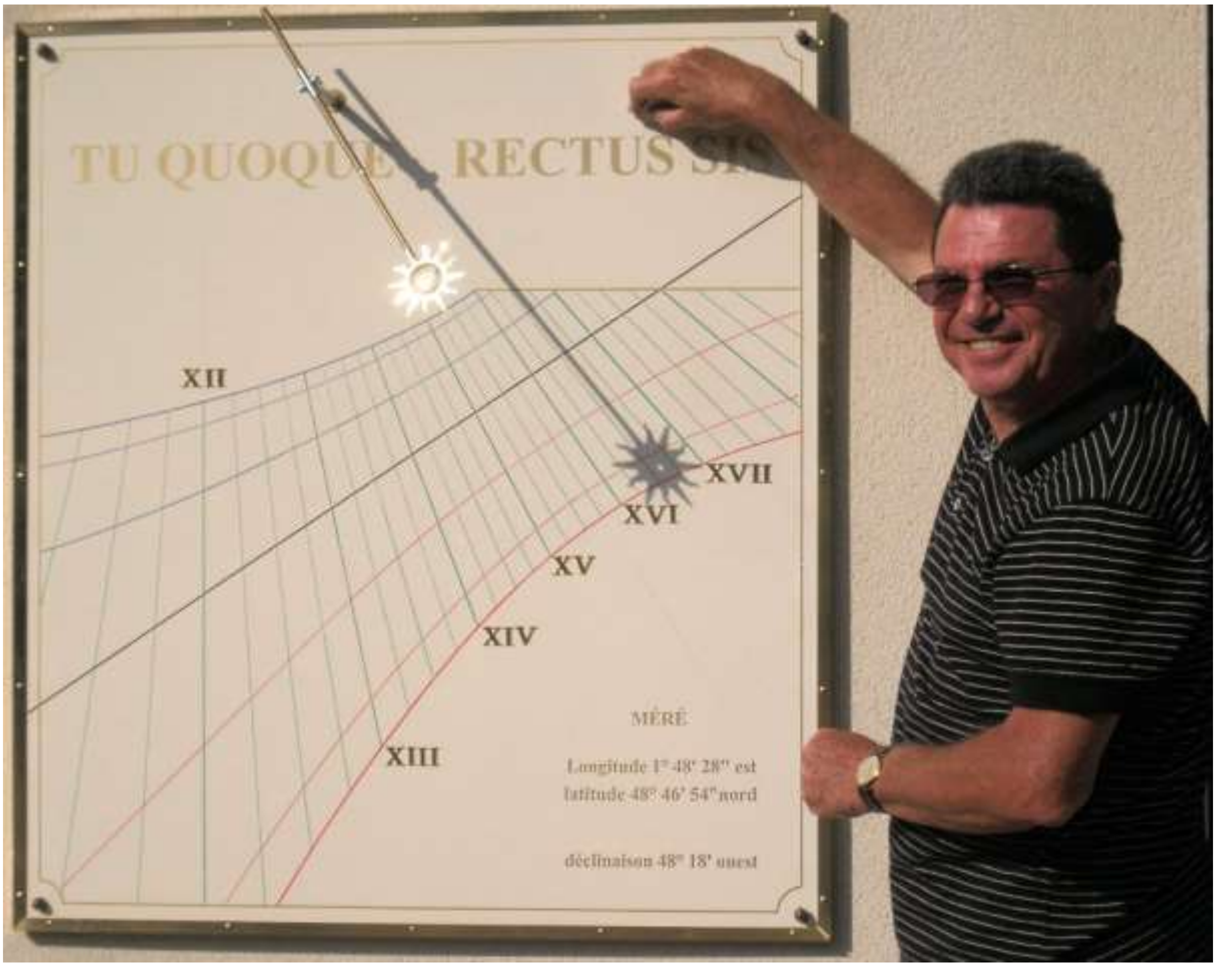
Adhesive roman numerals are bought in a store.

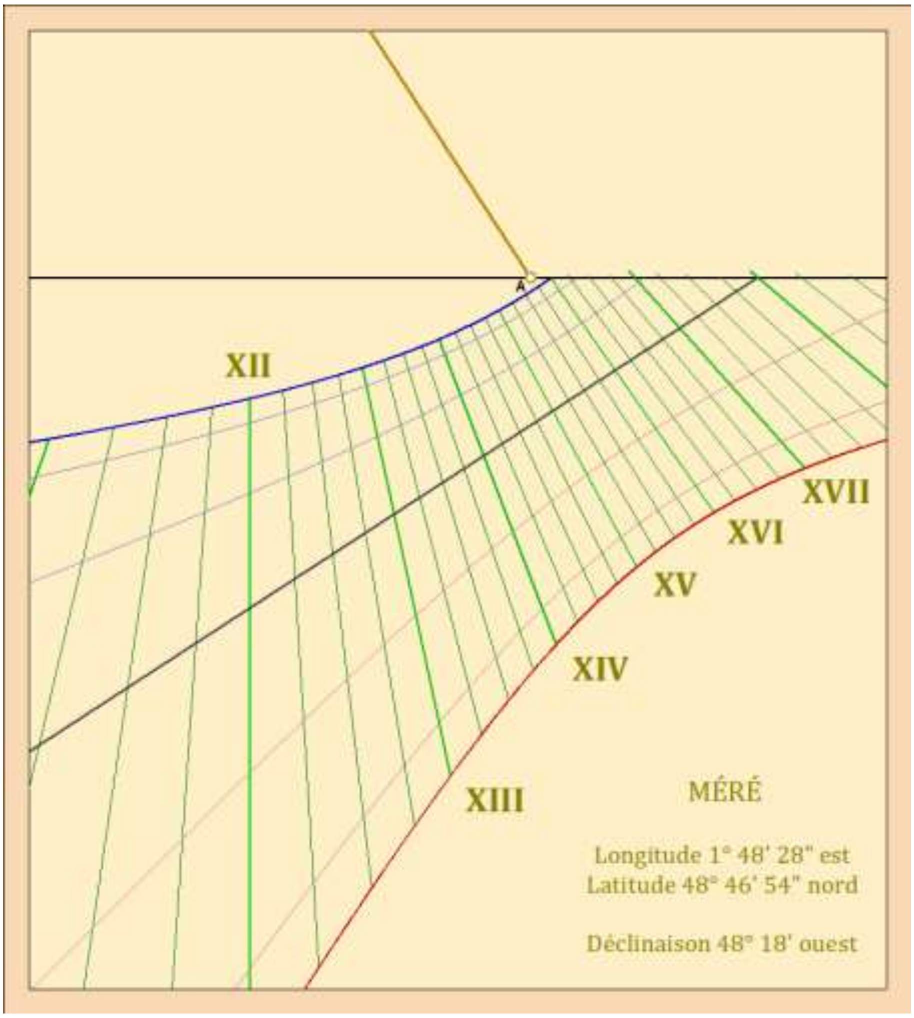


The frame is made with brass corners.

The sundial is installed after checking it parallelism with respect to the wall.

The fixture is made from threaded rods sealed in the wall. Nuts are installed behind the sundial to adjust the position, and then other cap nuts allow the final fixture.





The reference layout was made with Shadows by selecting a vertical declining sundial, made for Méré (which was added to the location database). The delination was entered according to the measurements made on the field.

The colour and thickness of lines can be adapted for each category (hours, half-hours, solstice, equinoctial line…)

Text frames can be added and moved around (here for the key in the lower right corner)