

# Alignment with the Wild T1A theodolite

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# 1 Overview



Figure 1: The Wild T1A theodolite on its tripod.

In order to line everything up, we place a theodolite behind the beam dump, open up the beam dump and the last gate valve GV2<sup>1</sup>

This document explains how to set up the theodolite for this procedure. You will need to sight two points in the beam line which are in the beam axis. To do this, place the circular plexiglas pieces with crosses etched on them in the beam line, so the cross is in the middle.

The model of theodolite we normally use is a Wild T1A theodolite, which hasn't been made since 1972. This document assumes you have this kind of theodolite.

## 2 Setting up the tripod

The first job is to set up the tripod. Place the forward leg on the orange line between the marker point E3 and the beam dump and the other two behind E3, either side of the orange line. In principle, you could have the legs in another way, but this has two advantages. Firstly, one leg is on the orange line, which helps setting it right and secondly there are no legs in the place where you need to stand!

In order to get the centre of the tripod exactly over the E3 marker, you need to use the optical plumb line. This is a small black lens which pulls slightly out of the T1A. If you look through it, you can see the floor directly under the theodolite. Move it in and out to adjust the focus. You should be able to see a sharp image of the marker.

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<sup>1</sup>In order to open GV2 you need to unplug the D-SUB connector going to the two TPG-262 gauges and jumper pins 3 and 4 together on each. One only has these two pins, so it is easy to see which ones. Then you can open with the button on the control box.

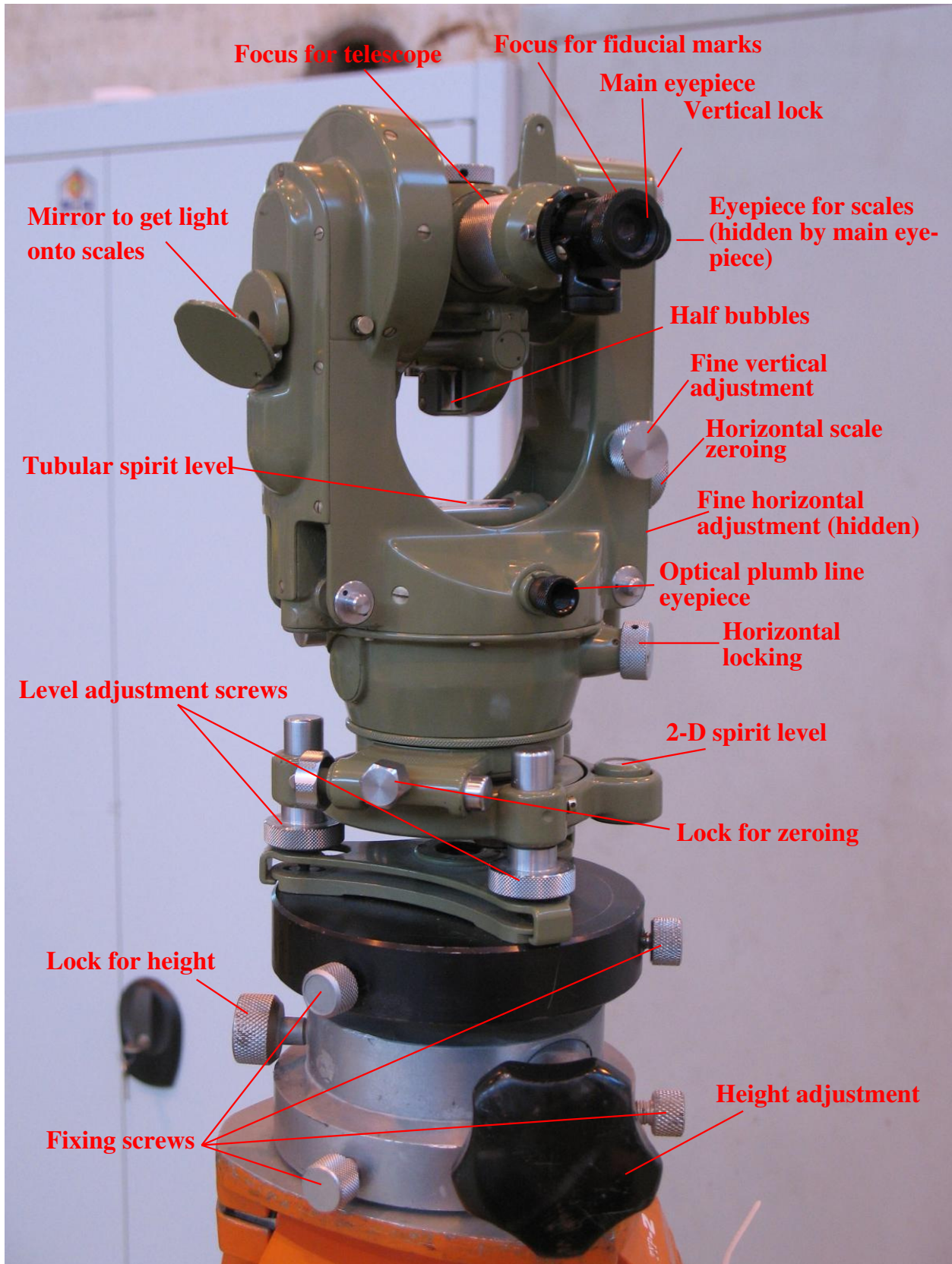


Figure 2: The Wild T1A theodolite.

However, this is only correct if the platform on which the theodolite sits is horizontal. There are three screws to adjust this and a two-dimensional spirit level with a bubble which comes into the centre when the theodolite base is horizontal.

This is, however, only a rough adjustment. To get the theodolite exactly horizontal, you need to use the tubular spirit level and you need to rotate it to different angles to get the plane horizontal and not just a single line. There is release knob, which when freed allows the theodolite to rotate freely about the vertical axis.

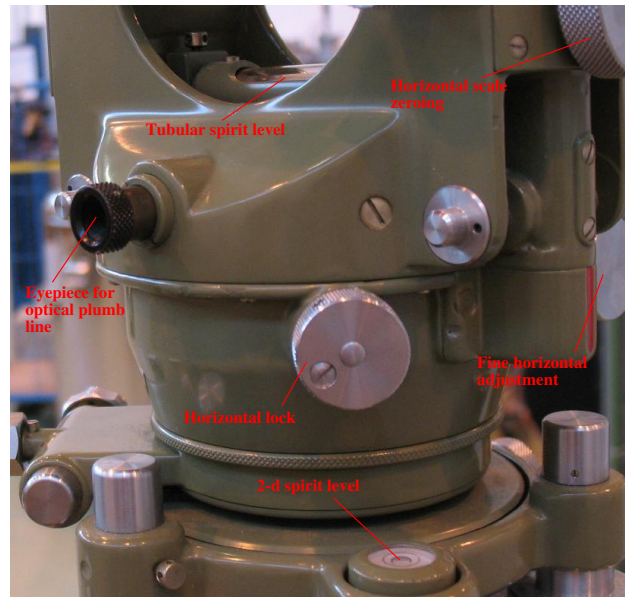


Figure 3: The eyepiece for the optical plumb line.

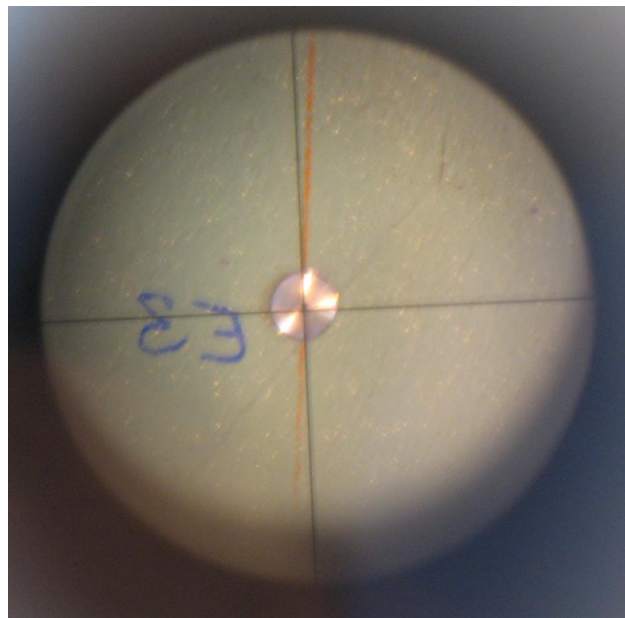


Figure 4: View through the optical plumb line. Note the image is inverted. The crosshairs should be right over the E3 marker.

For the tripod to be set right the following conditions have to be satisfied:

- The optical plumb line shows the theodolite is exactly vertically above the E3 marker (i.e. the crosshairs are centred on it).
- The 2-d spirit level has its bubble in the centre.
- If you rotate the theodolite about its vertical axis, the tubular spirit level remains centred for all rotations.

Since the only way to adjust is by adjusting the tripod legs and this changes all these things, it is an iterative process and is quite tedious.

Once you have done this, the theodolite is centred on the marker E3 and its base is in a horizontal plane, so when it rotates about its vertical axis, it remains centred on E3.



Figure 5: The 2-d spirit level with the bubble in the middle indicating the base is more or less horizontal.

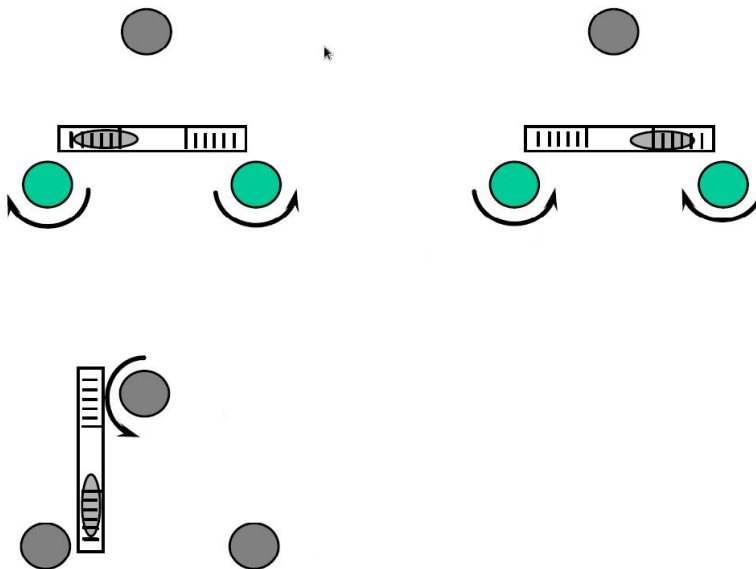


Figure 6: Get the bubble to the centre of the tubular spirit level as shown in the top two diagrams, then rotate the theodolite by  $90^\circ$  and adjust the third screw as shown in the bottom diagram.

### 3 The scales

Next to the main eyepiece, through which you sight objects, there is a second smaller eyepiece. If you adjust the mirror so that light shines down the hole by the mirror it illuminates the display. Alternatively, get a small penlight and shine it directly into the hole. You can then see three illuminated scales. The lower one is for the azimuthal angle. It is possible to zero this by unlocking the lock for horizontal zeroing which allows the whole theodolite assembly to rotate about the vertical axis without rotating the two parts relative to another. However, usually, a relative scale is good enough, so it is not worth the effort.





Figure 7: The tubular spirit level with the bubble in the middle. Note this is much more sensitive than the two dimensional one, but you have to rotate about the vertical axis to check the whole plane, not just a line.

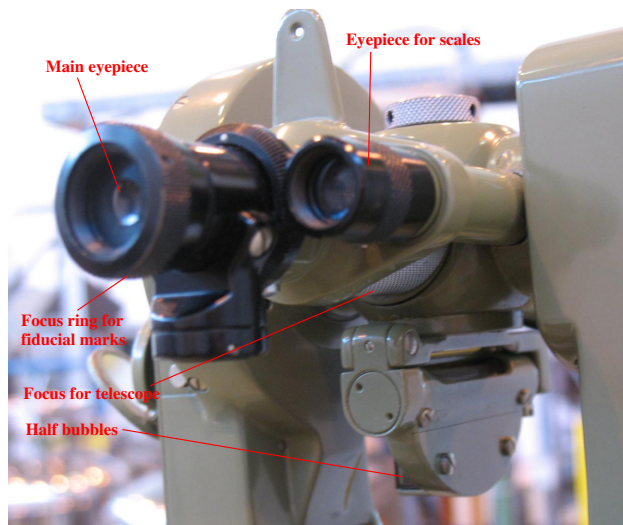


Figure 8: The eyepieces.

## 4 Aligning the height

Before you set the height right, you need to make sure the eyepiece is horizontal. To do this, there is a piece sticking down from the eyepiece (or up if you have it the other way round - the eyepiece can go either way) with a view of two halves of a bubble. When these line up, it is correct.

Once the eyepiece is horizontal, adjust the outer focus ring to focus on the fiducial marks which are part of the theodolite. Then adjust the inner focus ring to focus on the crosshairs in the beam line.

The big black knob on the tripod at the base of the theodolite is used to adjust the height. This is locked by the locking knob. Be careful when you release the locking knob that you hold the black knob tightly to prevent it from suddenly slipping, as the whole weight of the theodolite is then able to turn the black knob.



Figure 9: The two half-bubbles. Here they are not quite lined up, so you can see that there are really two halves. When the eyepiece is horizontal, they line up correctly.