

Arana-1 Spectrometer Kit Assembly Instructions

Copyright © 2013 Creative Consulting for Research & Education
<http://ccreweb.org/hardware/spectrometer/>

Last Revised: 9 December 2013

I Inspection

Identify the following labeled components to ensure you received a complete kit. If any items are missing or damaged, please email us at krishna.myneni@ccreweb.org .

Base Plate (1) – a drilled wood plate, 2” wide by one of the following lengths: 6”, 8”, or 10”, and ¼” thick. The base plate is painted black. *Your kit may include additional base plates of different lengths.*

Slit Plate (1) – a drilled aluminum plate, 3¼” tall by 2” wide by 1/8” thick, and has a aperture for light to enter the spectrometer. The slit plate is painted black.

Grating Holder (1) – a rectangular wooden holder for the diffraction grating card. The grating holder is painted black and a warning sticker or label is attached to the side of the grating holder facing to the back of the spectrometer.

Mask or Viewing Plate (1) – a rectangular wooden plate, 9 1/2” wide by 3” tall by 1/4” thick, with a rectangular aperture. The mask plate is painted black on one side, the side facing to the back of the spectrometer, and painted in colors on the front facing side.

Top Plate (1) – a rectangular wooden plate, identical in size to the mask plate. The top plate is painted black on one side, the down facing side, and painted in colors on the top facing side.

Diffraction Grating Card (2) – a 2” x 2” card within which is mounted a holographic film diffraction grating with 500 lines/mm. The diffraction grating card is held by the grating holder. A 2” wide by 1/2” tall by 1/16” thick wooden shim is also provided to enable a snug fit of the card within the grating holder.

Light Shield Material (1) – a square or rectangular piece of black poster-board, to be cut to the appropriate size and folded to make a light shield for the spectrometer.

Hand Grip (1) – a round wooden dowel, 1/2” in diameter, used to hold the spectrometer when viewing a light source. The hand grip is unpainted, and has a mounting hole on one end, to attach to the base plate.

Entrance Slit Knife Blades (2) – two precision knife blades used to form the narrow slit through which light enters the spectrometer. *The knife blades are sharp! Be careful in handling them!*

Screws – these are the wood and sheet metal screws needed to hold various components together:

(7) #6-3/4” wood screws, flat phillips head (two are extras)

(3) #4-1/2” sheet metal screws, round phillips head

(4) #4-5/8” sheet metal screws, round phillips head, with four #6 flat washers.

II Tools and Materials Needed for Assembly

You will need the following tools and materials to assemble the spectrometer:

- ruler
- pencil
- scissors
- roll of black vinyl electrical tape (3/4" wide), e.g. Scotch 700 Commercial Grade
- Phillips screwdriver

Additional tools that *may* be needed:

- thin round metal file

III Some Assembly Tips

a) Before fastening components together with screws, check the alignment of the through-holes on one component, with the pilot holes for the screws on the other component. Since the pilot holes are drilled into wooden components, there is a good bit of tolerance in the alignment. However, if the overlap of the holes is off by more than about 20%, you may consider elongating the through holes, in the appropriate direction, using a round metal file.

b) When fastening components which should be at right angles in the horizontal plane, in particular, when mounting the mask plate to the base plate, hold the components firmly together in the proper orientation when fastening, or they may rotate as you screw them together.

c) Since most components are made from wood, they are not

designed to be repeatedly disassembled and reassembled – the screws won't be gripped as tightly after they are removed once. However, even in the case where the screws don't tighten down completely, as long as the two components are rigidly mated without any wobble, there is no need for concern. In the event the two components are not rigidly mated, it should be possible to apply some wood filler (Elmer's wood filler, for example) to the screw threads, to regain a firm hold between the two components.

IV Assembly

Assembly of the spectrometer is anticipated to require less than one hour.

IV.1 Base Plate Selection

If your kit includes more than one length of the Base Plate, find the length which is best suited to your near vision. Hold up a printed page close to your face, and find the closest distance at which the print is clearly in focus. Select the base plate length which is less than, but within two inches of your closest distance of near focus.

IV.2 Slit Plate Assembly

Remove the two *Entrance Slit* knife blades carefully, and place them on the *Slit Plate* as shown in the picture below:



Position the knife blades to cover the vertical length of the aperture in the slit plate, so that they form a narrow vertical slit in the horizontal center of the slit plate aperture. You will want to achieve a slit width of approximately the thickness of a hair, and it may take a couple of trials to obtain a usefully narrow slit.

Remove one of the blades temporarily, leaving the other one in position. Cut several small strips of black electrical tape, $\frac{3}{4}$ " by about $\frac{3}{8}$ — $\frac{1}{2}$ " wide, and have them ready. Placing your finger on the blade in position and pressing down to hold it in position, affix one of the tape strips to hold the blade, on its left edge, to the plate. Then, use another strip to hold the blade on its right edge. Do not obscure the slit area with the tape.

Place the other blade back into position, and hold it position with

two tape strips also. The assembly should look as shown below.



Hold up the slit and look at a light source through the slit to check its width and overall rotation from vertical. If the slit appears too wide, or is not vertical with respect to the edges of the plate, remove the tape strips from one or both blades, re-position the blade(s), and re-affix with the tape strips.

Although it may seem that you should make the slit as narrow as possible, avoid the temptation to do so. A very narrow slit has the disadvantages that it will admit less light, making the observed spectra dimmer, and is susceptible to being obscured by dust, creating horizontal dark lines in the spectrum. The slit should be less than about half of a millimeter in width, however.

Once the entrance slit is formed to the anticipated width and vertical orientation, use additional tape strips, at the top and bottom of the blades, to hold them securely to the *Slit Plate*.

Next, attach the assembled *Slit Plate* to the front of the *Base Plate*, using the three **#4-1/2” screws**. Hold the slit plate firmly in position while tightening the screws.

IV.3 Attach the Grating Holder

Using two **#6-3/4”** screws, attach the *Grating Holder* to the *Base Plate*. Use the set of two through holes farthest to the back of the base plate (holes farthest from the slit plate). The correct orientation of the grating holder will result in the warning sticker facing the back of the spectrometer.

IV.4 Attach the Mask Plate

Using two **#6-3/4”** screws, attach the *Mask Plate* to the *Base Plate*. Use the set of two through holes in the base plate which are three inches in front of the grating holder mounting holes. The black side of the mask plate faces the grating holder. Hold the mask plate firmly when tightening the screws from below the base plate, so that it does not rotate with respect to the base plate.

IV.5 Attach the Top Plate

Using the four **#4-5/8”** screws with washers, attach the *Top Plate* to the top of the *Mask Plate*. The black-painted side of the top plate should face down towards the base plate.

IV.6 Attach the Hand Grip

Using one **#6-3/4”** screw, from the top of the base plate, attach the hand grip, using the end of the hand grip with the pilot hole.

Tightening this screw will require a bit more torque, since the pilot hole is made narrower to ensure a very tight mating with the base plate. Use one of the center-drilled holes on the base plate (3a – 3c on the base plate drawings) for attaching the hand grip: 3a for the 6”, 3b for the 8”, and 3c for the 10” base plate.

IV.7 Make and Install the Light Shield

Cut, fold, and tape the black poster-board to the open part of the spectrometer between the slit plate and mask plate, to shield the grating from light paths other than through the entrance slit. See the [Aruna-1 Drawings Folder](#) for the light shield dimensions, and the fold lines, for the different base plate lengths. Use strips of electrical tape to hold the light shield onto the spectrometer. The front of the shield should overhang the slit plate by about 1”. Use the tape to ensure that no light passes into the spectrometer from around the edges of the slit plate.

Congratulations! You are now ready to use the Aruna-1 spectrometer!