

Arc Furnace User Manual

Arc Furnace Safety

- The arc furnace uses an arc of electricity to melt the sample. The arc produces a high level of UV light, which can cause damaged to the eyes. **DO NOT LOOK AT THE ARC.** To prevent exposure to yourself there is a welding shield which has to be placed in front of the furnace. To prevent exposure to those around you there is a curtain around the surrounding area which needs to be closed before beginning.
- As with any furnace there will be a hot surface, which can cause serious burns. When melting use the heat resistant gloves and allow sufficient time to cool before removing your sample.
- To produce an arc a high voltage is needed. Do not touch any exposed wires and ensure the power is turned off before handling the arc furnace.
- The arc furnace uses a pump to create a vacuum in the sample chamber. This puts a lot of pressure on the quartz window. Before starting, just check the window to ensure there are no cracks that could cause the quartz window to break when the pump is turned on.

Arc Furnace Components

Fig. 1 shows the Copper crucibles used to strike the arc and melt the sample in. The two on the left are used for making rods, while the two on the right are used for making “lumps” of your compound.

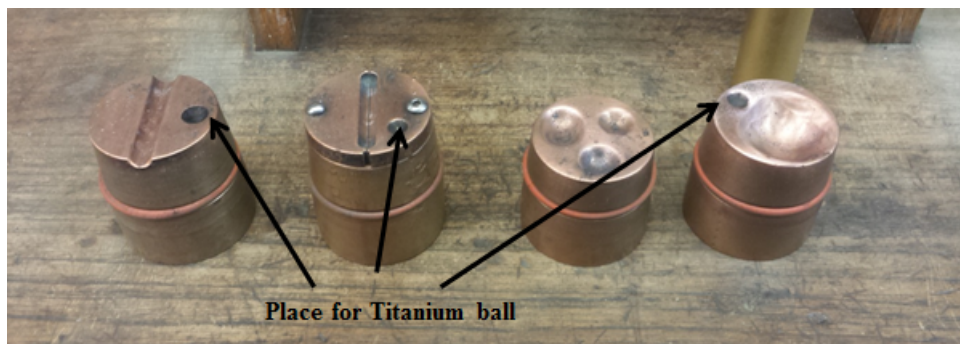


Figure 1: Different types of Copper crucible used in the arc furnace.

Fig. 2(a) shows the arc furnace. The long silver rod (with the red end) is the vacuum attachment to the arc furnace. Fig. 2(b) shows the electrode, this strikes the arc. The tip is made of tungsten. Fig. 2(c) shows the reaction chamber, both the top and the bottom are water cooled.

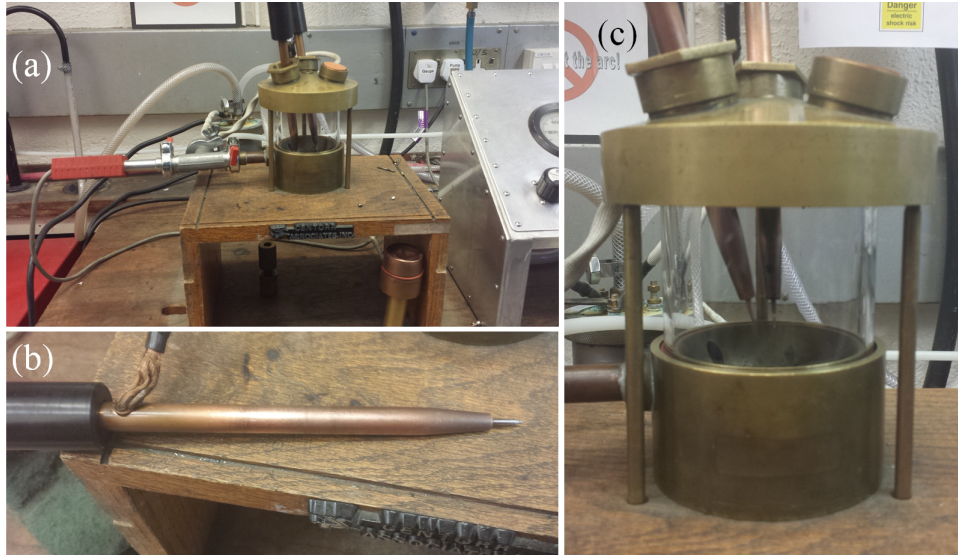


Figure 2: Different parts of the arc furnace. (a) The entire arc furnace, (b) The electrode and (c) The reaction chamber.

Fig. 3 shows the panel that controls the the vacuum pump and the argon flow into the chamber.

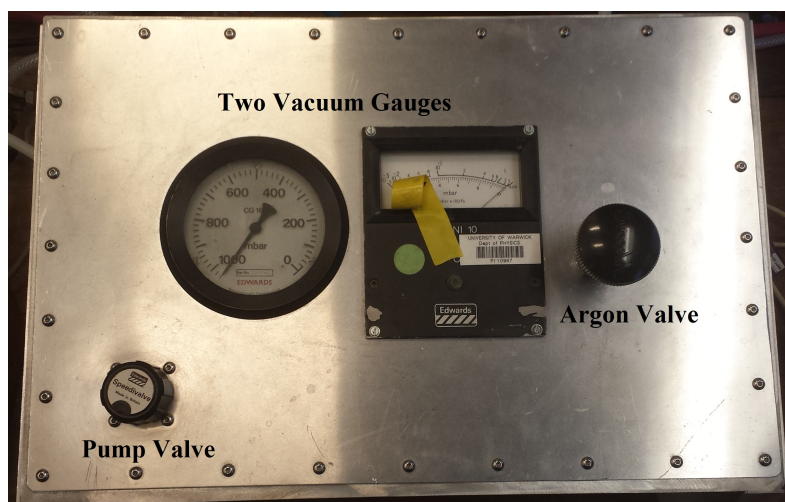


Figure 3: The control panel which controls the vacuum pump and argon flow.

Using the Arc Furnace

Step 1: Clean the arc furnace (See Section below).

Step 2: Place the elements/ compounds you want to melt in the copper crucible (Fig. 1). The copper crucible on the far right is the one most frequently used. Place a clean titanium ball in the pit.

Step 3: Turn the pump and gauge on at the wall.

Step 4: Attach the copper crucible to the brass support and place the copper crucible into the chamber and open the pump valve (Rotate dial anti-clockwise).

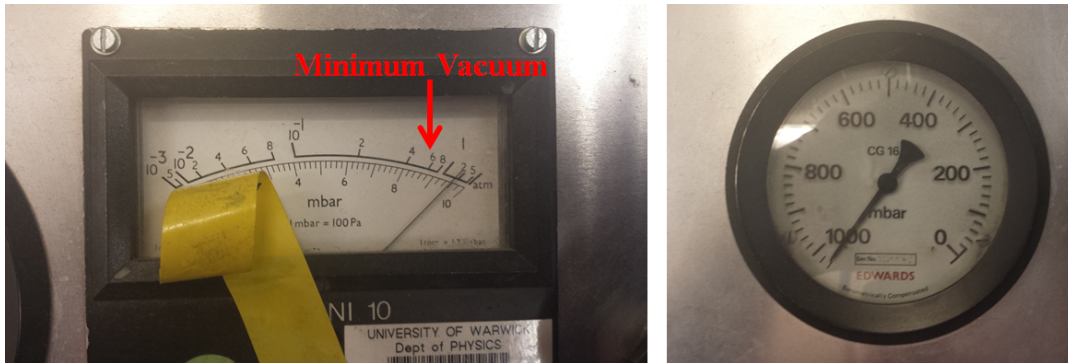


Figure 4: The two vacuum gauges.

Step 5: Check the butterfly nuts are still finger tight and place support under the copper crucible to ensure it does not fall out. You will now have to wait for a good vacuum. Fig. 4 shows the minimum value you should aim for (using top scale). Pump for about 3-5 minutes to make sure you have a reasonable vacuum as well.

Step 6: You need to flush the chamber with argon at least three times. To do this turn the Argon valve anti-clockwise, once the circular gauge reaches 1000 mbar, you will hear a slight pop. Close the Argon valve and then open the pump valve. Repeat this, except on the third time leave the Argon valve slightly on.

Step 7: Place the shield in front of the arc furnace (Fig 5(a)).

Step 8: Put the heat resistant gloves on (Fig 5(b)). You now have to turn the water on using the tap (Fig. 5(c)). Behind the arc furnace is a small plastic case with a red ball in it (Fig 5(d)). This is used to gauge the water flow. Ensure the red ball is going around before proceeding at a reasonable rate, 1 click per second is normally fine.

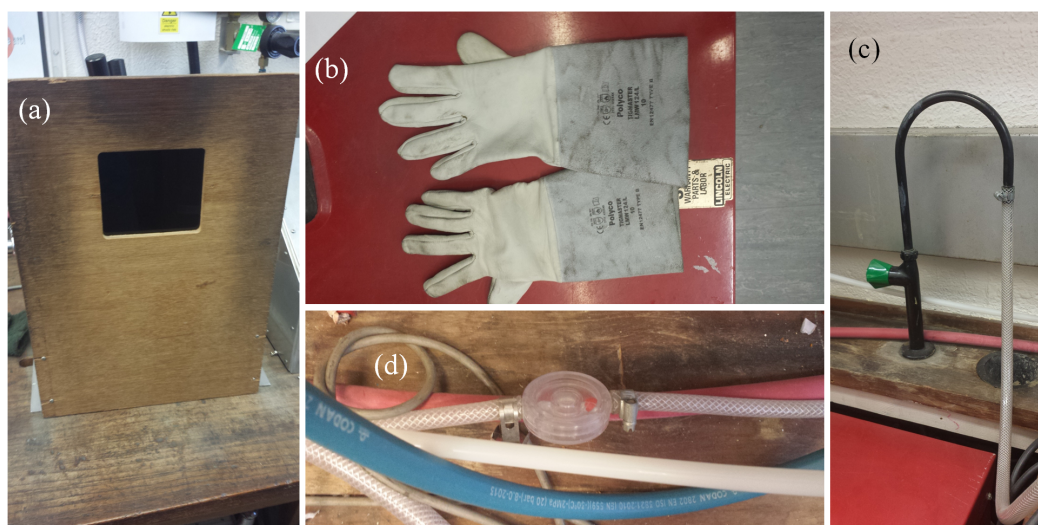


Figure 5: (a) UV shield placed in front of arc furnace. (b) Heat resistance gloves. (c) Tapes used to turn the water on and (d) gauge of the water flow.

Step 8: Everything is now ready to begin melting the sample. First of all turn the power on at the wall (Fig. 6(a)). Check the control output is set to 0 and then press the green button to turn on the welding power source when you are ready to begin (Fig. 6(b)).

Step 9: To strike an arc turn the output control to 6/7 (Fig. 6(b)). Push the electrode against the copper crucible and pull away slowly to ensure you do not lose the arc. Move the arc over the titanium ball and melt the titanium first. This is to ensure there is no oxygen in the chamber. Once the arc “jumps” onto the titanium ball, turn the output control down. This ensures the arc does not vaporise the titanium.

Step 10: Turn the power off by setting the control output to 0 and pressing the red button. Perform a visual check of the titanium ball, if it is clean and shiny, turn everything back on and melt the elements, if it is discoloured flush the chamber with argon again and attempt to melt the titanium again.

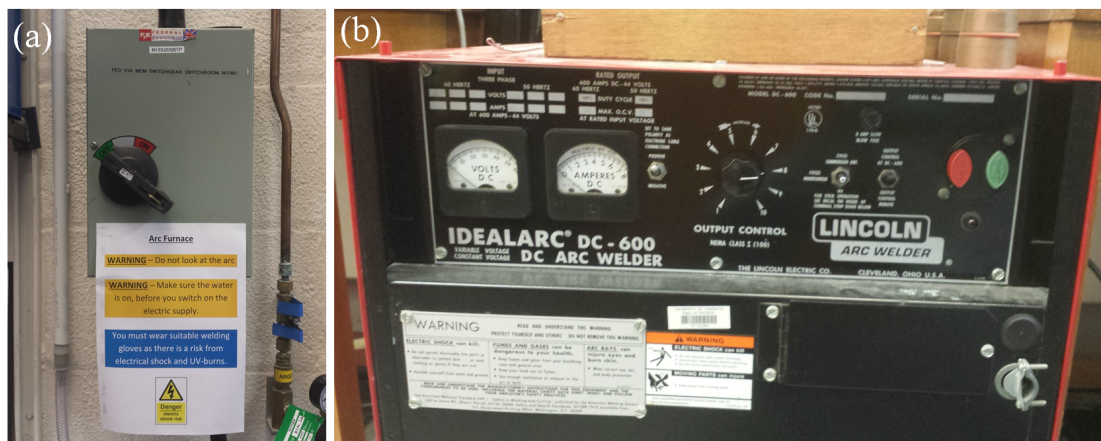


Figure 6: (a) Power source for the welding unit and (b) control panel for the welding unit.

Step 11: Melt the elements together in the same way the titanium ball was melted. Once finished, turn the power off. Close the argon valve and wait for the crucible to cool down. Once cool take everything out and clean the copper crucible. After melting a few times you will have to clean the entire arc furnace.

Cleaning the Arc Furnace

You should clean the copper crucible after each melt, however cleaning the entire arc furnace can be done less frequently depending on what you are melting. For example melting borides will require more frequent cleaning compared to other compounds, but as a rule of thumb you normally clean the arc furnace after 6-10 melts.

Step 1: Ensure everything is turned off.

Step 2: Take apart the arc furnace. Start by unscrewing the butterfly nuts, these are located underneath the chamber.

Step 3: Take the top off, hold the quartz window and lift off (Fig. 7). Be very careful not to knock the quartz window. Place the window to the side in a safe place.

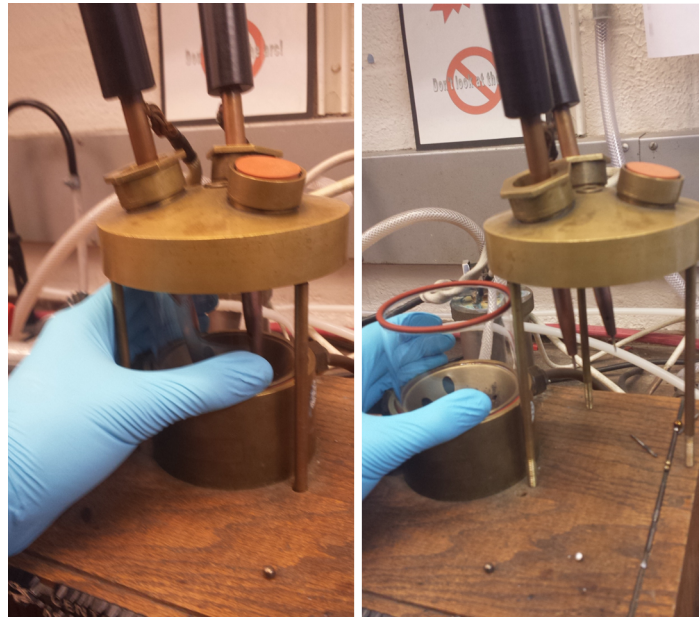


Figure 7: Removing the top from the arc furnace.

Step 4: Clean everything (except the window) by scrubbing it with scotch blight (Fig. 8(a)). Spray a bit of solvent (Ethanol/Methanol) into a tissue (Fig. 8(b)) and use it to clean the surface (Fig. 8(c)).

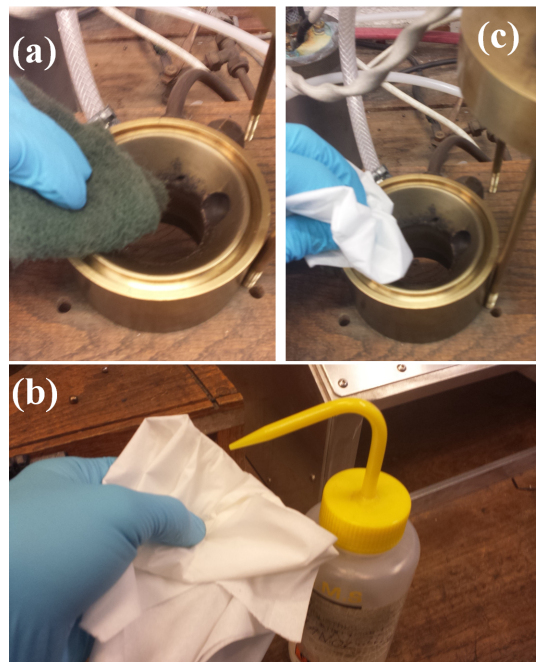


Figure 8: Cleaning the arc Furnace.

Step 5: Clean the quartz window by spraying the tissue with solvent and wiping it.

Step 6: Put everything back together, take care again when putting the top back on to the quartz window.