The OPN Stir Plate: An Inexpensive, Open-Source Laboratory Stir Plate

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**Introduction**

Stir plates are laboratory devices that typically use a magnetic field to cause a stir bar immersed in liquid to spin at high speeds. The magnetic field is created using either a rotating magnet or stationary electromagnets. Stir plates are an essential piece of laboratory equipment and have utility in nearly all chemistry and biology laboratories. A number of stir plates are available for sale such as the Apera Instruments® Model 601 and Scilogex® 81132102 MS-H-S10. Stir plates are relatively expensive with costs ranging from $45.00 to $650.00, not including shipping and taxes [1-3].

As a way to bring down the cost of laboratory stir plates and make the technology more widely available to all, this manual describes how to construct a personal laboratory stir plate with an estimated cost of $15.00. This manual also describes how to use this stir plate so that any user can mix liquids for laboratory experiments. The inspiration for the OPN Stir Plate comes from similar designs available online [3-5]. The goal of this design was to simplify these designs and make them more affordable in the process.

Finally, in keeping with the names given to the other instruments and pieces of equipment developed in the OPN Lab, our stir plate is called the **OPN Stir Plate**. This name is used because the device’s plans are open-source and publically available for all to use. We hope that the **OPN Stir Plate** will be a useful tool that circumvents the cost of expensive alternatives.
**Constructing the OPN Stir Plate**

The construction of the *OPN Stir Plate* uses parts readily available online, at thrift stores, or in most hardware stores (lamp dimer, 12V computer fan, and a 6V power source). For readers without easy access to a hardware store, there are a number of online vendors (Newegg®, OutletPC®) that offer affordable electronic parts and necessary hardware pieces.

**Constructing the OPN Stir Plate**

To make and configure the *OPN Stir Plate*, readers will need the following materials:

- Toshiba DC 12V, 0.3Amp Brushless computer fan
- One 0.39 x 1.14inch (diameter) wooden dowel
- Two pieces of 2.0 x 5.0 x 0.75inch softwood
- 7.0 x 5.0 x 0.08inch piece of clear Plexiglas
- One piece of 7.0 x 5.0 x 0.75inch softwood
- Two XSPC 1.25inch Phillip screws
- Class 2, 6V, 200mA Power Supply
- Power drill with 0.25inch drill bit
- Two small wire nut connectors
- Lutron 120V Lamp Dimmer
- 2inch Ceramic Bar Magnet
- 100 Grit Sandpaper
- Super Glue Gel
- Epoxy Glue
- Wire Cutter
STEP 1:

• Use wire cutters to trim the blades of the 12V computer fan. (Fig. 1, 2)

Figure 1: Wire cutters should be used to carefully remove the blades from the central rotor.

Figure 2: The frame of the computer fan should be intact after blade removal.
STEP 2:

- Use 100 grit sandpaper to sand the face of the 12V computer fan’s central rotor. (Fig 3)

Figure 3: Using 100 grit sandpaper is recommended for hand sanding of the central rotor.
STEP 3:

- Use super glue gel to attach the 5.0 x 0.75inch face of the two pieces of 2.0 x 5.0 x 0.75inch softwood to the ends of 7.0 x 5.0inch face of the 7.0 x 5.0 x 0.75inch piece of softwood. This will form the base for the *OPN Stir Plate* (Fig. 4)

**Figure 4:** The base of the *OPN Stir Plate* can be constructed using any type of wood.
STEP 4:

- Use epoxy glue to attach the wooden dowel to the face of the 12V computer fan’s central rotor. (Fig. 5)

Figure 5: The wooden dowel should be centered on the central rotor.
**STEP 5:**

- Use epoxy glue to attach the long thin edge of the ceramic magnet to the wooden dowel. (Fig. 6)

*Figure 6:* The ceramic magnet should be allowed to sit for five minutes to allow for proper drying of the epoxy glue.
STEP 6:

- Use wire cutters to remove the output plug of the Class 2 6V power supply. (Fig. 7)
  - Make sure that power supply is unplugged for this step.
  - Upon removing the output plug, the cord-bundle can be separated into two cords: one with white stripes and one without.
- Strip 1.0inch off the output ends of the striped and plain cord.

Figure 7: When using the wire cutters to trim the power supply make sure not to cut too far past the output plug.
STEP 7:

- Center the fan apparatus on the base structure, constructed earlier.
- Using a power drill with a 0.025inch drill bit, predrill two holes in the base, using the frame of the fan as a guide.
  - Predrilled holes must be on opposite corners of the fan’s frame.
- After predrilling the holes, attach the fan apparatus to the base structure using two XSPC 1.25inch Phillips screws. (Fig. 8, 9)

Figure 8: The power drill should be used to predrill holes for the XSPC screws to be used later.
Figure 9: The fan apparatus must be centered on the base structure.

**STEP 8:**

- Use the 100 grit sandpaper to sand a 1.0inch border along the 5.0inch lengths of the fiberglass. Be sure to only sand one side of the plate of Plexiglas.
**STEP 9:**

- Use super glue gel to affix the Plexiglas to the raised borders of the base structure such that the sanded ends of the plate are in contact with the wood. (Fig. 10)

**Figure 10:** The Plexiglas plane should perfectly line up with the walls of the base structure.
**STEP 10:**

- Twist the exposed copper wiring from the Class 2, 6V power supply cord with stripes around the exposed wiring of the red cord of the 12V computer fan.
- Insert the twisted bundle of wires into a grey wire connector. (Fig.11)
- Twist the copper wiring from the Class 2, 6V power supply cord without stripes around the wiring of the black cord of the 12V computer fan.
- Insert the twisted bundle of wires into a grey wire connector. (Fig.11)

*Figure 11: Be sure to properly connect the wires from the 6V power supply and 12V computer fan.*
STEP 11:

- Plug the Class 2, 6V power supply into the 120V Lutron lamp dimmer. (Fig. 12-14)

Figure 12: Make sure the 6V power supply is plugged into the 120V Lutron lamp dimmer prior to turning on the device.

Figure 13: Be sure the 120V Lutron lamp dimmer is on the lowest setting prior to turning on the device.
Figure 14: This image shows the completed *OPN Stir Plate*. 
**Using the OPN Stir Plate**

Using the *OPN Stir Plate* safely and effectively requires an understanding of both the mechanical and electrical components of the device. To turn on the *OPN Stir Plate* plug the AC adapter of the Lutron lamp dimmer into any three-prong household or industrial electrical outlet.

**Using the Lamp Dimmer:**

The Lutron lamp dimmer will serve as the speed control for the *OPN Stir Plate*. Before turning the device on, place a magnetic stir bar in a beaker filled with liquid. Center the beaker above the ceramic magnet on top of the Plexiglas. Upon turning the device on, the stir-bar should begin spinning in the beaker. By adjusting the slider on the lamp dimmer, the speed of rotation can be adjusted.

If the stir-bar is bouncing around the beaker, the speed is too fast and should be reduced. If a small vortex does not form in the liquid being mixed, the speed of the stir-bar is too slow and speed should be increased. The ideal speed is one at which the liquid being mixed is stirred into a vortex which does not spill liquid and does not cause the stir-bar to move erratically in the beaker.

It is very important that the power supply is used. We used a 6V power supply with a 12V fan. Our original designs used a 12V and were unsuccessful. If the power supply used is 12V, the apparatus will not be adjustable and will shake violently. This may lead to accident and/or injury in lab. You may have to experiment with different power supplies to find the right combination for your device. One should never use a higher voltage of amperage power supply than is noted on the computer fan.

**Hazards**

There are a few safety hazards to be aware of in construction of and use of the *OPN Stir Plate*. During construction of the device, be sure that no cords are plugged in until the device is fully completed [4, 5]. Premature activation of the fan can result in a sharps injury and or electric shock if in contact with exposed wire. Once the device is completed, rotor speeds should not exceed appropriate levels for the liquid being mixed [5]. Failure to do so may result in broken glassware and or a sharps injury. One should never leave the *OPN Stir Plate* on and unattended. Use caution when operating this device and make sure to keep hands and clothing clear of the rotating fan and wiring. Upon turning off the device, allow ten to fifteen seconds for the central rotor to stop spinning [5].

**Disclosures**

I declare that I have no conflicts of interest related to any product, brand, company, website or other item discussed in this manual. As well as with other open-source instruments and equipment developed by this lab, we encourage readers to improve upon the designs and methods set forth in this manual by using other materials and equipment. We urge them to bring their own insights and inspirations to the project.
References


