# Building a Zig-Zag Seed Cleaner

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*For future updates check out the **Zig-Zag Seed Cleaner Blog here**.*

*Note: This machine was fabricated as one piece of our mobile seed cleaning unit which contains numerous pieces of seed cleaning equipment including a Clipper AGM 224 Air Screen Separator and is available to borrow through our seed equipment library.*

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There are lots of different ways to clean seed - which is the process of separating the seed from the rest of the plant debris to make it suitable for planting or selling. It is important to choose a seed cleaning method that is fast, effective, and appropriate for the type of seed you are cleaning.

The three main ways we clean seed are:

1. Separation by size, using screens
2. Separation by weight, using air flow
3. Separation by density, using a gravity table.

There are other ways to clean seed as well – but these three are the most common methods.

While there are many high-end air-driven seed cleaning machines on the market, such machines can also be made at home or on farm using readily available materials – reducing the cost of this seed cleaning method significantly. One of the well-known designs for a homemade air separator is the zig-zag seed cleaner, the building of which we will describe in detail here.

The zig-zag seed cleaner works, in short, by creating a column of air which sucks the lighter seed into a separate chamber from the heavier, better-quality seed. A portion of the air column narrows, which increases the air pressure, drawing the lighter seeds and chaff through. Once the seed has passed through the narrow gap there is a drop in pressure as the gap widens - causing the seeds to drop down and now get sucked up through the air-suction mechanism (also known as a vacuum!). Pictured here is a commercial version of this type of seed cleaner. The zig-zag portion of the cleaner refers to the back and forth motion the seeds are subject to when they are dropped down the seed chute which keeps them suspended longer for easier suction of lighter materials.

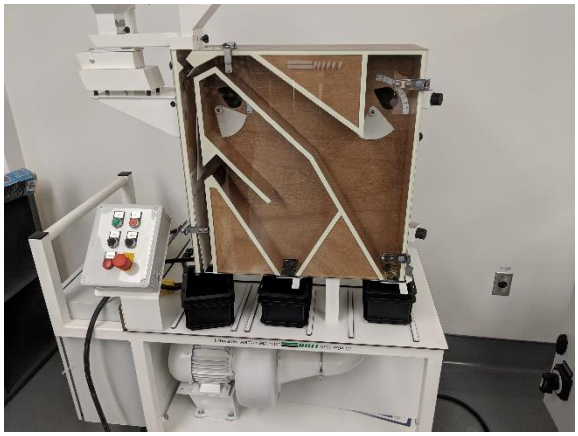
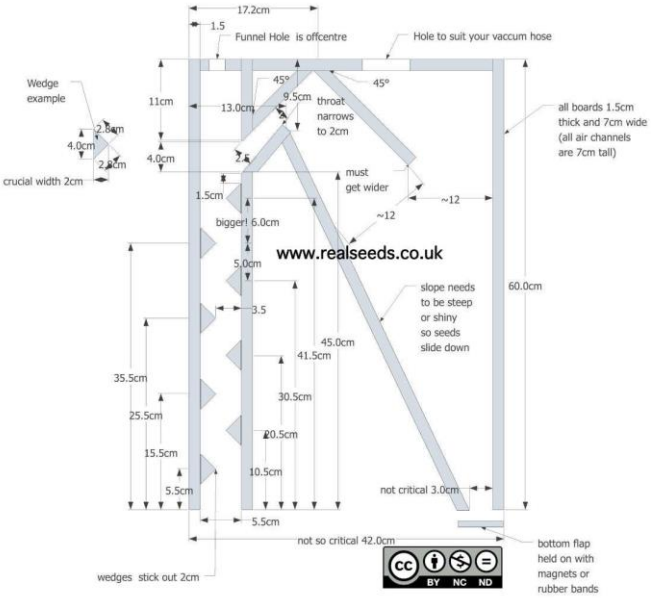


*Figure 1: Pictured here is a commercial version of the zig-zag air separator*

The homemade version we fabricated is based on a design shared online from [www.realseeds.co.uk](http://www.realseeds.co.uk) . It is made of wood and plexiglass and powered by a good-quality vacuum. Using this design as a starting point, this article details the steps we went through to build the machine.




I will list the steps here in order with a note: After building the machine (which took about 6-8 hours) I realized a significant flaw in the design: the machine itself was pretty much impossible to clean. Thus, the design needed to be altered to allow easy access so the machine can be cleaned out between batches of seed. The steps below take this into account in the proper order – not as an afterthought! After adjusting the design to make the plexiglass into a door that opens and shuts, we discovered that this is how the commercial version of the machines are also made (shown above).

With all the steps below, this project will take about 20 hours and cost about $325 (including the vacuum, which can be used for other purposes as well).

**Step 1: Build an online model**

Using the schematics given on the Real Seeds website we built a 3D model of the seed cleaner in SketchUp. This allowed us to get a better "look" at the machine from all angles before building it. It also helped us better understand how it will come together during fabrication. Further. It allowed us to easily scale to model size up or down, which is exactly what we did. Once the design was complete we increased the size by 25%, while heeding the warning from the Real Seeds website – that doubling the machine in size requires 4 times the suction power. Judging by the power of the vacuum referred to in the original design, and knowing the power of the vacuum we would use for our own design, we felt comfortable with a 25% size increase.

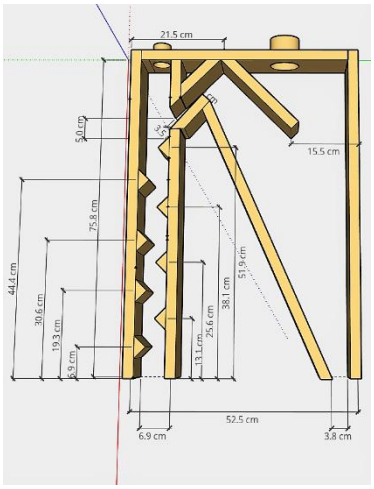



*Figure 2: A 3D model is useful for changing the dimensions of the machine and getting a good look from multiple angles before building.*

You can download an ***image of the 3D design here*** and you can get the ***SketchUp file*** by emailing us at bcseeds@farmfolkcityfolk.ca.

The SketchUp file has most of the dimensions incorporated into the design. Missing dimensions can be calculated easily with the given dimensions as some dimensions were hard to incorporate into the model given time restraints.

**Step 2: Make a Materials List and Gather Materials & Tools**

Using the design, we then made up a materials list to make shopping easy. **The materials are as follows:**

- 1" x 4" lumber – for them main structure
    - 2 x 8-foot pieces
- Half sheet - ¼" plywood
    - For structure backing
- 1" x 2" lumber – for plexiglass door
    - 8 feet
- Wood Glue
    - Strengthens connections and fills gaps between wood
- 4 mm plexiglass
    - 52.5 cm x 76 cm
- Screws
    - 1 ½" for assembling main structure
    - ¾" for plexiglass door
- Drill bit
    - For pilot holes before screwing
- Hole Saw
    - 1" diameter for seed drop and vacuum insert holes on top of the machine
- 3 x Cabinet Hinges
    - Most small-sized cabinet hinges will do
- 4 x Chest Clasps
    - For closing and sealing the plexiglass door
- Weatherstripping
    - ¾" width and Amount
- Vacuum
    - Ridgid WD4070 vacuum with 5.0 HP (~100 CFM)
- Metal brackets for door
    - 4-6 SIZE
    - To strengthen door

**Tools required:**

- Mitre Saw for cutting lumber
- Skil saw for cutting plywood
- Measuring Tape (metric)
- Drill for pilot holes and screws
- Exacto knife for cutting plexiglass
- Sandpaper (medium and fine) to smooth out wood

With the material list in hand you should be able to head to a local hardware store and pick up most of the material on one trip, though we got the plexiglass from a local art store.

**Step 3: Cut Materials to Size**

Once we had all the materials procured we could start with fabrication. This starts with cutting the lumber and plywood to size. The exact plywood dimensions are, though we made our plywood a bit taller to create a bit of a handle and a future foundation for affixing additional components

Because there are some precise angles involved in this design, it is important to use a good-quality mitre saw to ensure the pieces fit snug when assembling. The mitre saw we used was a little off, making the end product a bit "loose" – resulting in some small gaps between pieces. In the end we filled these with wood glue – which added additional time to the assembly.

The angle on the top pieces is ***45 degrees*** while the angle on the narrow column between the seed chute on the left and the large section on the right is approximately **38 degrees**. This angle difference causes the column to narrow, creating a pressure differential which sucks the light seeds and chaff through then causes them to drop.

After the pieces have been cut, sand them to a smooth finish so there is less friction for the seeds. Use a medium-grit then a fine-grit sandpaper.

**Step 4: Lay Out Materials and Assemble**

Once all the lumber pieces and the plywood were cut, we laid them out on top of the plywood backing to ensure they fit. After confirming the pieces were all cut properly we laid them out a final time on top of the plywood and traced them with pencil. This helps us align them later when assembling and helps us more accurately drill pilot holes. After this ee could then start gluing and screwing them together. Essentially we are gluing and screwing the lumber pieces to the plywood to start.

Assembling the machine is fairly easy, but here are a few tips:

- Drill pilot holes for all screws to avoid wood splitting
- Assemble the "seed chute" portion on the left of the machine first. This will make it easier to attach the triangle pieces which know the seed around as it drops through the chute
- Glue all portions before screwing for a stronger fit an easier screwing. It is recommended to clamp each piece while the glue dries, but it has a good hold after 1 or 2 minutes allowing you to drill pilot holes and insert the screws
- Runa thin bead of glue along all seams between pieces of wood to fill any gaps where seed may get stuck. Wipe away excess glue with your finger while wearing nitrile or latex gloves.

*Figure 3: Tracing where each of the pieces sit on the plywood helps to drill the pilot holes.*

*Figure 4: Gluing the wood before screwing makes the machine much more sturdy and helps seal wood seams.*

Once the frame is glued and screwed in, the weather stripping can be added. It can be stuck on the top end of the lumber. The weather stripping will make sure there is a good seal when the plexiglass door is closed and the machine is in operation.

**Step 5: Attach Chaff Release Door**

The right side of the machine, the large compartment, is where the small seed and chaff are sucked into. They will fall to the bottom of the compartment as the pressure drops just past the narrow channel. The door at the bottom of this compartment is a simple piece of wood with a hinge. We made the door a little on the big side so it wedges itself shut.

**Step 6: Drill Seed Chute and Vacuum Insert Holes**

The next step is to drill holes in the top of the machine for the seed chute and the vacuum access. We started with 1" diameter holes.

Hole positioning is important. The seed chute hole (on right side) should be very close to the middle of the chute, while the vacuum hole (left) should be positioned nearer the centre over the piece of angled wood below it.

For the seed chute we started with a 1" threaded male steel coupling inserted into the hole with a 1" female PVC coupling attached to it above. It is important that this hole is small so as not to lessen the suction. A hopper can be attached to the female PVC coupling for making it easy to feed the seed into the machine.

The vacuum hole can be cut to fit the vacuum you are using or can remain small and fitted with an adapter for larger diameter hoses.

*Figure 5: Vacuum hose adapter from Ridgid*

**Step 7: Testing**

Before fabricating and attaching the final plexiglass door it is a good idea to test the cleaner to make sure there are no major issues that may be more difficult to address once the plexiglass door is attached. Here we used some scrap pieces of greenhouse polycarbonate that we had access to.

This is closer to the original design, but as you can see it is not easy to remove the panels which makes cleaning the machine either impossible or tedious. Cleaning any seed cleaning machine is essential to prevent contaminating subsequent lots of seed.

This design will eventually have stand which will hold it up off the ground to allow room for a bucket underneath to catch the seed (chaff and small seed will fall in the compartment on the right with the release door.

**Step 8: Fabricating the Plexiglass Door**

Once the machine is tested and ready to go you can start with the plexiglass door. We made a simple design that was solid and easy to build. We cut the plexiglass to size using an Exacto blade. Then using the same technique as with the lumber and plywood, we placed the frames pieces onto the Plexiglas and traced them with a pencil to help line up our pilot holes for he screws. Without a pilot hole plexiglass will crack easily.

Once the frame is traced and the pilot holes are drilled the frame pieces can be attached with the screws.

To strengthen the door, we added straight brackets to the corners. This will help prevent the door from warping over time.

Place the door on top of the frame to make sure it is a good fit and prepare it for attachment.

*Figure 5: Brackets help strengthen the plexiglass door*

*Figure 6: Place the door on the machine to ensure it fits!*

**Step 9: Attach the Door**

The door will be affixed to the machine in two ways: with brackets and chest clasps. We want the door to fit very tightly so it is well sealed when the machine is in operation. To do this, we positioned the door on the machine then placed heavy weight on top, which essentially compresses the weather stripping under the door. While the weights are on the door, start by attaching the hinges on one side. Once the hinges are attached, attach three clasps on the opposite side and one at the top. This will ensure the door is well sealed and held tight when in operation.

*Figure 7: Here you can see the weights still on the machine after the clasps have been affixed.*

Once the hinges and clasps are attached the weight can be removed. Now comes the real test – can you open the door?! The weather stripping will hold onto the plexiglass tightly and it will be hard to open - so open it slowly and carefully.

*Figure 8: Close up of the clasps*

*Figure 9: The machine has a single clasp on top, positioned in the centre.*

**Step 10: Final Details & Celebrating With a Cold Beverage**

With the attachment of the door, the machine is near completion. Though here are a few further considerations (which we are still working on):

- You can see from the image to the right that we left a portion of the plywood above the machine. This is for future use as a handle or to affix additions (e.g., seed hopper and vibrating motor).
- An electrical outlet with a dimmer switch can be added into which the vacuum can be plugged and the voltage reduced to reduce the suction. The original model has an opening with a door that can be adjusted to let in more air and reduce the suction. We will experiment with both.
- We increased the size of the seed chute hole to make it easier to feed seeds (especially larger seeds) through - but this reduced the efficacy of the machine by drawing in too much air and reducing the suction power. With this in mind - it is important that this opening stay at 1". We will remedy this when adding a seed hopper. The hopper is important as it can help control the seed feed rate, but also help automate the unit so it does not need to be attended to constantly.
- The machine should be cleaned between seed batches to ensure one seed type does not contaminate another (especially smaller seed contaminating larger seeds). To clean the machine, open the plexiglass door and use an air compressor to blow out and remaining seed and chaff.
- The machine can be sanitized with a light spraying off a bleach or hydrogen peroxide solution. This is important for long-term use and preventing disease transmission between seed batches.
- Here is the ***full collection of pictures and videos*** we have for the seed cleaner, describing the seed cleaner and showing it in action during the testing phase.
- Like any machine, it will take some time to get to know this one and make it operate effectively to properly clean seed. Be patient as you learn to use the machine and, in the process, learn which seeds it works best with.
- Enjoy a good cold beverage when you are done building the Zig-Zag Seed Cleaner – you deserve it!