



xTool F1 Air Scrubber

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Summary

DIY Air Scrubber/Fume Extractor for the xTool F1.

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Tags: [filter](#) [fumeextractor](#) [scrubber](#) [exhaustduct](#)
[fumeextraction](#) [xtool](#) [airscrubber](#) [xtoolf1](#)

13 January 2024: Included an upgraded Filter Module (FilterModuleHighVolume.stl) that holds about 30% more pellets than the old one with no changes to the outer profile. Also included a STEP file of the whole thing for adjustments or remixes (using 90 deg plenum and high volume filter module). Updated description to have clickable links to parts from Amazon.

This is a DIY air scrubber designed for the xTool F1 laser engraver. It attaches to the exhaust port on the back of the F1 (directly with the 90 deg attachment, or via the exhaust hose with the Straight attachment) and filters/scrubs the exhaust using a HEPA filter and activated carbon bed.

Inspired by the renown [BentoBox](#) 3D printer chamber filter, and developed around the same time as my other [scrubber](#) for the BambuLab P1S.

The device consists of 3 primary modules connected together with M4 nuts/bolts and magnets with an O-ring seal between each.

Plenum: Air intake attaching directly to the F1 (using 90 Degree attachment) or to the F1's exhaust hose (using straight attachment).

Filter Module: Uses a robovac HEPA filter, followed by a box of activated carbon pellets. Carbon pellet box has a lid that slides on/off for refill when needed. Robovac filter presses into a recess in one side. The High Volume version hold more pellets and takes less material to print, but requires some overhangs that some printers might struggle with.

Fan Module: Houses 2x inline 40mm fans to pull air from the F1 through the HEPA filter and carbon pellet bed, and out the top of the unit. Fans are separated by a stator vane. The fans press-fit into each end of the fan module during assembly. The fans are installed, then spliced together to a single 4-pin female fan plug which connects to a PWM fan controller. The controller's knob fits through the hole in the top of the fan module. I highly recommend using the linked Arctic fans to achieve the suction required to pull air through the filter media.

The Electronics Cover has 2 holes. One for the 12v DC power jack, and another for an optional in-line On/Off switch. Behind the cover is a recessed cavity which contains all wiring and the back ends of all electronics components. The Fan Cover fits into the top with a small tab. Each cover uses a small countersunk screw to hold in place.

Printing:

Recommend printing one piece at a time unless you are very confident in your slicing/prep skills and performance of your printer. I printed all components on a Bambu Lab P1S using basic PLA and Polylite PETG as an interface layer for supports. If you have an AMS or other multicolor printing capability, the "xTool F1 Fume Extractor v2" text on the electronics cover can be printed in a contrasting color.

Settings: 0.4mm nozzle, 0.2mm layer height, 3 wall loops, 3 top/bottom layers, 15% cubic infill. Supports are needed for all parts except the Straight Plenum and fan/electronics covers. I used a mix of tree/normal supports depending on the piece, and 6+mm of outside brim on all pieces to help bed adhesion.

The Fan Module is trickiest to print due to the electronics box. Bambu Studio auto-supports created a 'plug' of support material in this cavity to hold up the 'ceiling' when printed upside down (air duct outlet down). This worked OK with PETG interface material, but could be more difficult without. I might re-design this in the future to minimize the need for supports in this cavity.

Assembly:

The plenums and filter module should all be fairly self-explanatory to assemble. Press-fit M4 nuts into the hex-shaped holes in the flanges on the plenum(s) and fan module. The fan module and filter-side of the filter module each have a deeper recess for O-rings to press into. Cut O-ring material to fit each recess and use CA glue to attach the material end-to-end. Let the glue dry, then press each O-ring into the recess (gland). Magnets press into holes at each interface, a dab of CA glue helps hold them in place in each hole. Ensure magnet poles are matched so pieces snap together properly.

For the electronics: Cut the 4-pin connectors off of each fan cable, and thread the cable through the slot from the air duct of the filter module into the electronics box, pulling to remove slack.

Guiding the cables down the 'slots' provided in the air duct & pulling slack into the electronics box, press the 40x28mm fans into each end of the Fan Module, making sure they are oriented the same direction - to pull/blow air out the top of the device. This is an intentional interference fit and may require some pressure. **Caution:** it is **very difficult** to remove the fans after installation. The loose end of each fan cable should be in the electronics box.

Next, delicately strip the ends of each set of fan wires and build a y-cable joining both sets of wires into 1 female 4-pin plug. Only 1 fan's PWM signal/sense line (3rd wire - use your favorite [wire diagram](#), it might be tricky keeping track of which wire is which) should attach to the female connector. I recommend both crimping and soldering each metal insert before pressing into the plastic connector body. Double check wire traces/orientation before final install.

Finally, install the sub-mini 12v switch and the 12v DC jack into the electronics cover, and the PWM controller into the hole in the top of the fan module with the male fan connector facing outward. Solder the (+ red) wire from the controller to one terminal on the switch, then solder a small length of red wire from the the other terminal on the switch to the (+) terminal on the DC jack (the center pin). Solder the black wire from the controller to the (-) terminal on the DC jack. Install the y-cable from the fans onto the male plug on the controller board. Push all wires into the box and slide the cover on. Plug into 12v power and check operation.

Optional: The sub-mini switch is not completely necessary, but is handy to set a fan speed on the controller, then switch the controller on/off with the pre-set speed.

With 90 deg plenum installed, press the device onto the xTool outlet and orient vertically like a 'backpack' on the back of the unit. Use an adhesive strip to secure the body of the scrubber to the back plate of the xTool. Switch fans on whenever engraving to knock down smoke/VOCs.

Additional parts and tools required:

- Qty (8) 10mm M4 bolts
- Qty (8) M4 nuts
- Qty (2) 40x40x28mm high-pressure fans (<https://www.amazon.com/dp/B09SB3Z6ND> - the 1400 to 15000RPM model)
- Qty (1) DC power jack (<https://www.amazon.com/dp/B07S5ZLFDG>)
- Optional: Qty (16) 6mmx3mm magnets (<https://www.amazon.com/dp/B09TPJ2J5Y>)
- 4-pin computer fan female plug interface (<https://www.amazon.com/dp/B08HYSHFQZ/>)
- PWM Fan Speed Controller (<https://www.amazon.com/dp/B0BHNC776L>)
- Qty (1) 12v DC power supply 2A+ (<https://www.amazon.com/dp/B01GD4ZQRS>)
- 2mm O-ring stock (<https://www.amazon.com/dp/B00R0VW4S8>)
- Qty (1) HEPA filter (<https://www.amazon.com/dp/B0782T7L6P>)
- Activated carbon pellets (<https://www.amazon.com/gp/product/B0C795JTSM>)
- Qty (2) small countersunk sheet metal screws to secure fan + electronics covers
- Optional: Qty (1) Sub-mini power switch (2 pin ON/OFF) that fits a 6mm hole (<https://www.amazon.com/dp/B08SQG4C39>)
- Soldering gun + solder
- Wire cutters & stripper, pliers for crimping.
- CA glue for magnets and O-rings.
- Adhesive strips
- Additional bolts, nuts, O-ring material, and magnets if using both the 90deg and straight attachments.

I use this M4 bolt set: <https://www.amazon.com/dp/B0B6J1SKZV>

Disclaimer: This product is not endorsed by xTool. The magnets are a bit extra and not completely necessary, though they do offer a very satisfying assembly experience. In fact this whole thing is over-engineered, but it was a fun project so what can I say. Also I am not the world's best hobbyist electrician so I'm sure there are better solutions for electrical power and fan control.

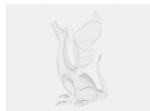
Version History:

v1: Initial design, unpublished.

v2 (1/8/24): Revisions for more effective carbon filtering, easier printing/support removal, and easier electronics install. Unit is taller overall than v1. Photos are of v1 with a smaller electronics cover and shorter carbon filter.

v2.1 (1/13/24): Added high volume filter module and made slight adjustment to the electronics lid to help it fit better.

Model files



xtoolairscrubber.step



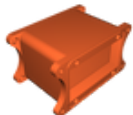
fanlid.stl

☐ Top lid for fan module

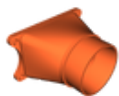


filterlid.stl

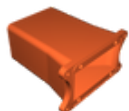
☐ Perforated lid for carbon filter box



filtermodule.stl



straightplenum.stl



fanmodule.stl



90degplenum.stl



filtermodulehighvolume.stl

☐ Refined filter module with larger internal volume + air louver.



electronicsliderefined.stl

☐ Cover for the electronics box.

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