Home-Made Box Fan Air Filters

One of the best ways to protect your health from wildfire smoke is to create and stay in a cleaner air space at home. Commercially available portable air cleaners with HEPA filters are ideal for removing small particles from the air, but they may not be easily accessible. A home-made box fan air filter can also help to reduce indoor concentrations of wildfire smoke in a small room.

If you choose to make and use a box fan filter:

- Use a box fan with a safety fuse and multiple speed options. Look for marks from recognized certifying organization such as the Underwriters Laboratories (UL), Canadian Standards Association (CSA) and Intertek ETL program.

- Use a high efficiency filter, preferably MERV 13 (FPR 10 or MPR1500-1900) or higher.

- Consider making a double (triangle) box fan filter, which creates less pressure drop by increasing the filter surface area (Figure 1, MIDDLE)

- DO NOT leave the fan running unattended

- DO NOT use the fan on high speed

- DO NOT block the back or the front of the fan – keep it away from walls, curtains, furniture, etc.

If you choose to make and use a home-made box fan air filter, there are limitations and potential risks that should be acknowledged.

- There is very limited peer-reviewed evidence on the effectiveness or safety of home-made box fan air filters.
- There is no clear guidance on when it is necessary to change filters on home-made units.
- Box fans are not designed to operate with a filter. The filter will create a pressure drop and increase the burden on the fan motor, potentially causing overheating, shortening the lifetime of the motor and creating a fire hazard.

**FIGURE 1:** Different types of air cleaners, including a commercially available portable air cleaner unit (LEFT, best), a double box fan filter (MIDDLE, better), and a single box fan filter (RIGHT, good)
SCIENCE IN ACTION

- There is very little scientific evidence on the effectiveness of box fan air filters, so more information was needed before recommending them in British Columbia.
- The BCCDC partnered with UBC to test box fan air filters in a special air pollution booth (Figure 2).
- Different filters and fan speeds were tested with different concentrations of fine particulate matter (PM$_{2.5}$).
- A tiny thermometer was used to measure the motor temperature with and without a filter attached.
- The study found that high quality filters at medium speed worked best (Figure 3) and that a single filter increased the motor temperature by about 2°C.

BOX FAN FILTERS WORK BETTER WHEN:

- Used in a small room (e.g. a single bedroom) that is kept at a comfortable temperature.
- Turned on for at least 15 minutes at medium speed.
- Run at moderate speed – higher speeds can blow smoke around a small room (Figure 3).
- Doors and windows to the room are closed.

FIGURE 2: The BC Centre for Disease Control partnered with UBC to test box fan filters in an air pollution booth (left) and a tiny thermometer was used to measure the motor temperature (right).

FIGURE 3: When the BC Centre for Disease Control ran trials of box fan filters at different speeds, it found that concentrations of fine particulate matter (PM$_{2.5}$) were most reduced at medium speed. The single filter used in this trial had a microparticle performance rating (MPR) of 1500.
SUPPLIES YOU NEED

- 20” x 20” box fan
- One or two 20” x 20” x 1” high efficiency furnace filters, preferably MERV 13 (FRP 10 or MPR 1500-1900) or higher
- Tape
- Marker
- Cardboard and scissors (for a double box fan filter)

Plug in the fan and turn it on to test the direction of air flow, and use the marker to draw an arrow from the back (where air goes in) to the front (where air comes out) on top of the fan.

For a double box fan filter:

- Cut two triangles out of cardboard with each side measuring 21” and each angle measuring 60 degrees
- Tape the two filters together along one side, make sure the arrows on the edges of the two filters point to the same direction
- Tape the tops of the two filters to one triangle, and the bottoms to the other triangle. Make sure the arrows on the edges of the filters point to the inside of the triangle, where the fan will go.
- Lightly tape both filters and triangles to the back of the box fan – using a lot of tape will put more strain on the fan motor.

For a single box fan filter:

- Align the filter against the back of the fan
- Turn the filter so that the arrows marked on the edges of the filter face the same direction as the arrow drawn on the fan
- Lightly tape the filter onto the fan – using a lot of tape will put more strain on the fan motor.