

UK Flow Optimised Circular Cage Fan Filter Box INSTRUCTIONS

Based on the Comparetto cube /
Corsi Rosenthal Box concepts
V1.1 (31 Jan 2022)

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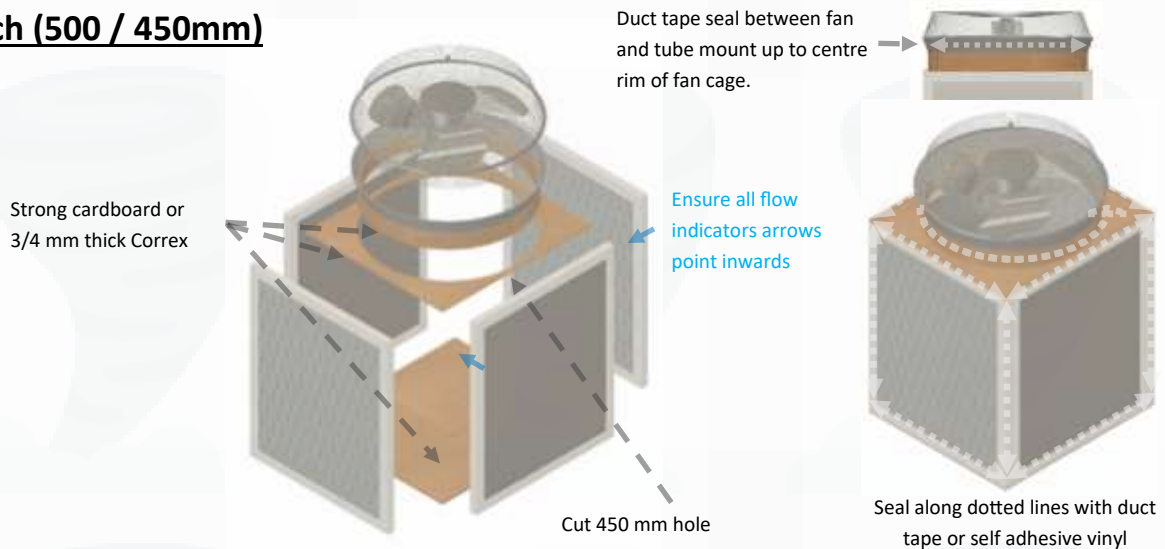
DIY circular cage fan filter box summary

(AKA Comparetto Cube or Corsi/Rosenthal Box)

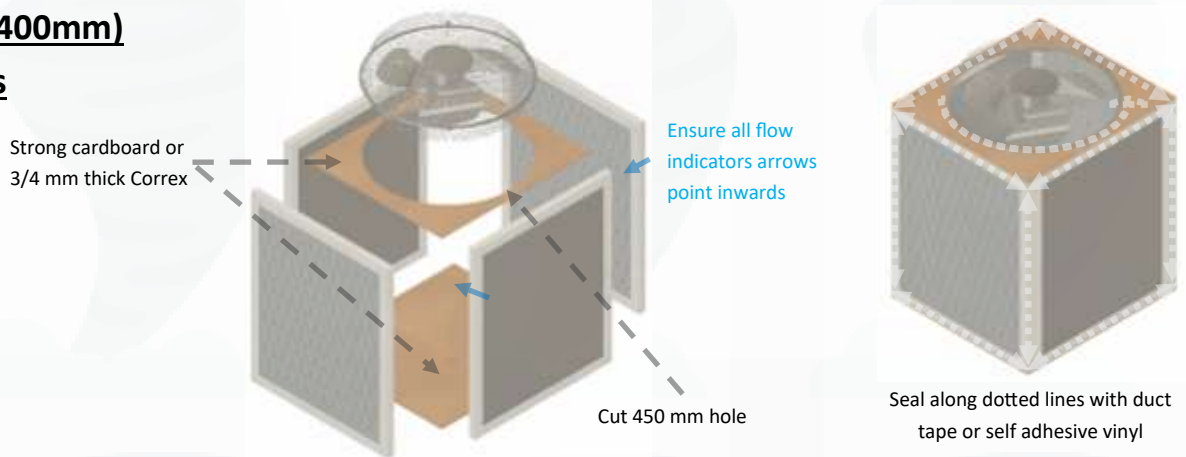
Fan Size	Tube mount for 20x20 inch square?	Mount hole size	Typical power rating	Noise range, (min speed, 1m distance)	Flow estimate range, (min speed)	CADR estimate, (min speed, 75% FERA CADR)
20/18 inch (500/ 450mm)	Yes	450 mm	100 - 120 w	50 - 55 dBA	1200 - 1700	900 - 1275
16 inch (400mm)	No	450 mm	80 - 100 w	46 - 52 dBA	800 - 1400	600 - 1050
12 inch (300mm)	No	345 mm	50 - 60 w	44 - 48 dBA	500 - 800	375 - 600

Values are coarse estimates only, assuming 4 x 20x25x1" Filtrete MPR1900 filters. Sound, flow, and CADR will vary considerably based on filter type, fan models and construction difference between each assembly. Assume end of life performance at (max 6 months) to drop by up to 50% of initial performance if using electret based filters. Prefilters and raising off the floor should delay filters becoming blocked by lint and large fibres.

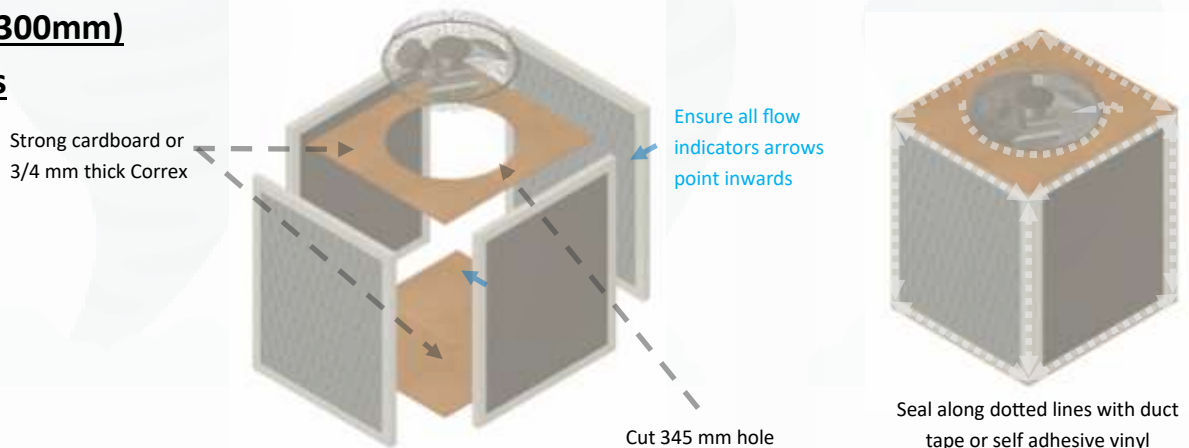
20 / 18 inch (500 / 450mm) cage fans

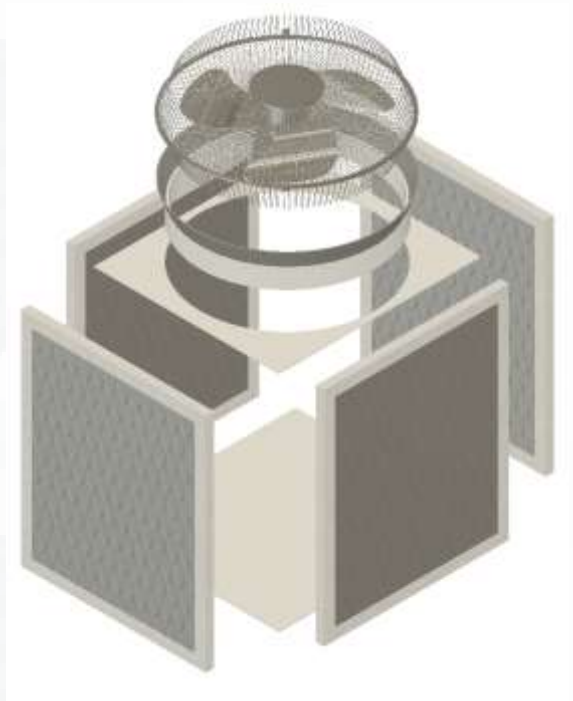


16 inch (400mm) cage fans



12 inch (300mm) cage fans





ASSEMBLY GUIDE



ASSEMBLY GUIDE

Bill Of Materials



Filters

4 x 20x25x1" Filtrete MPR 1900

To evaluate alternative filter options use:
UK DIY CR box calculator, link at bottom of next page.



Construction media

3/4mm Correx in white A1 sheets.

Alternatively strong cardboard can be used.

Adhesive

White duct tape

Or white adhesive vinyl



Cage fan

1. Prem-i-air EH0522 18inch (45cm) Cage fan 100W
2. NETTA NT-103771 18inch (45cm) Cage fan 120W
3. HYDOR HVFB-450 18inch (45cm) Cage fan 110W

If the above are not available, search for floor fans with
18inch (45cm) size and between 100-120w rated power.

Tools required

Stanley / craft knife with spare blades

1m rule or tape measure

Permanent marker

Scissors

ASSEMBLY GUIDE

Performance Estimates

Basic 18" cage fan filter box build



Difficulty: LOW

Filters

4 x 20x25x1" Filtrete MPR 1900, no prefilters

Estimated filter lifespan: 2-4 Months (8hrs / day use)

Fan

Prem-i-air EH0522 18inch (45cm) 100w Gym fan

Mount

Simple Tube mount sealed up to middle of fan cage with duct tape

			Initial Performance					Minimum performance (end of filter life)
			75%	70%	60%	70%	97%	50% of Initial CADR
			FERA= Filtration Efficiency for Respiratory Aerosols					
			FERA CADR					
			Smoke CADR					
			CADR					
			Pollen CADR					
Fan Speed	Flowrate (m3/hr)	Sound (dBA)	DIY sound rating	Respiratory Aerosols m3/hr	0.09-1µm m3/hr	0.5-3µm m3/hr	5-11µm m3/hr	m3/hr
1	1335	51	Borderline for classroom tolerable	1002	530	939	1294	501
2	1548	55	Borderline for classroom tolerable	1155	611	1085	1491	578
3	1867	61	Borderline acceptable in noisy environments	1550	820	1454	2003	775

Optimised 18" cage fan filter box build



Difficulty: HIGH

Filters

4 x 20x25x1" Filtrete MPR 1900, mesh prefilter and raised off floor

Estimated filter lifespan: 4-6 Months (8hrs / day use)

Fan

Prem-i-air EH0522 18inch (45cm) 100w Gym fan

Mount

Top an bottom tube mount with 6 blade swirl vane outlet.

			Initial Performance					Minimum performance (end of filter life)
			75%	70%	60%	70%	97%	50% of Initial CADR
			FERA= Filtration Efficiency for Respiratory Aerosols					
			FERA CADR					
			Smoke CADR					
			CADR					
			Pollen CADR					
Fan Speed	Flowrate (m3/hr)	Sound (dBA)	DIY sound rating	Respiratory Aerosols m3/hr	0.09-1µm m3/hr	0.5-3µm m3/hr	5-11µm m3/hr	m3/hr
1	1909	50	OK for classroom	1432	758	1343	1850	716
2	1955	54	Borderline for classroom tolerable	1466	775	1375	1894	733
3	2118	59	Borderline communal area tolerable	1739	920	1631	2246	869

For details of values were estimated and other configurations see [UK DIY CR Box Calculator spreadsheet](#)

ASSEMBLY GUIDE

1. Fan Preparation

Step 1.1:

Remove the centre badge.

This step is to prevent the badge from working itself loose, rattling during operation and increasing noise emissions of the fan.



Step 1.2:

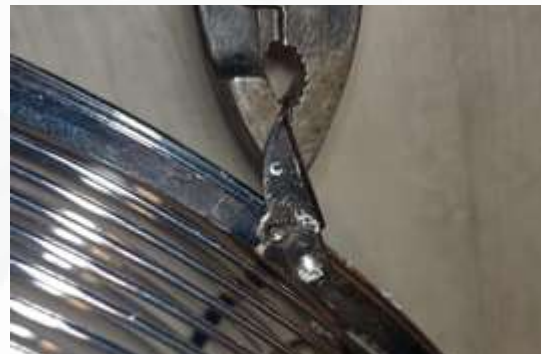
Remove the nut and screw at the base of the fan cage.

If using an adjustable spanner, ensure it is clamped tight to the nut.

Step 1.3:

Unclamp the toggles around the cage.

Use a spanner or pliers to prevent repetitive skin injury.



Step 1.4:

Remove the nut and bolt holding the fan legs rubber mounts in place either side of the rear cage.

Remove the legs from the fan assembly.

Ensure the nut, bolt and rubber mount do not remain loose inside the cage when finished.

ASSEMBLY GUIDE

1. Fan Preparation

Step 1.5:

The toggle clamps will likely have splayed open upon removing the cage.

Use a pair of pliers to pinch them closer together.

This will ensure the fan cage halves are securely clamped together, to prevent additional uncomfortable noise from the cage ringing.



Step 1.6:

Place the front fan grill back in place on top of the fan.

Line up the two halves of the cage ensuring the two holes at the bottom overlap.

Tighten down the securing nut and bolt back into place.



Step 1.7:

Push the toggle clamps back in place around the perimeter.

Use pliers to prevent skin injury.

Step 1.8:

Using a pliers or adjustable spanner, curl over the two tabs of metal sticking out either side of the cage where the legs were attached.

To prevent metal edges sticking out the side of the fan.



ASSEMBLY GUIDE

2. Filter Box



Step 2.1:

When storing filters, keep them in their sealed packaging.

(Protects against high humidity >60-90% RH during storage.)

Remove the packaging, take care not to damage the filter surface.

Step 2.2:

Make a square using duct tape.

Ensure flow arrows pointed inwards.



Step 2.3:

Place A1 Correx sheet on a clean floor.

Mark the filter box square and cut 2 squares.

Place cardboard underneath to protect floor when cutting.



ASSEMBLY GUIDE

2. Filter Box

Step 2.4:

Place first square on top of the filter box.

Duct tape 2 edges of the assembly.

Safety note: Ensure Correx doesn't overhang filter box to prevent sharp edge.



Step 2.5:

Trim away overhanging Correx on opposite edges, cut at angle.

Tape over two remaining edges.



Step 2.6:

Remove front fan cage.

Place centrally.

By eye is good enough.

Mark the outline with permanent marker perpendicular to the sheet/floor.

Do not hold marker at an angle.

Mark a dashed line 15mm inside the outline of the fan cage line.

Keep 15mm away from edges.

Join the dashes. Carefully cut with craft knife.



ASSEMBLY GUIDE

2. Filter Box

Step 2.7:

Place filter box assembly to one side.

Trim off the long edge from one of the A1 Correx offcuts.

Carefully cut into four 75mm wide strips.



Step 2.8:

Bend and curl each strip.

Best to duct tape over the cut edges to be sure.

Work your way around the previous cut hole.

Pin in place with short strips of tape along the edge.

Repeat and overlap 4 strips.

Ensure no gaps between the tape when finished.

Don't worry if not perfectly curved. Can be easily manipulated into shape later.

Tape along top of the cylinder you've made to make it all behave as one strong continuous curved piece.



ASSEMBLY GUIDE

2. Filter Box

Step 2.9:

Place on top of open side of filter box assembly.

Tape along sides.

Trim off any Correx that overhangs the filter square, as previously instructed for Step 5.

Lay continuous strips of duct tape along the edges and trim to length with scissors.



Step 2.10:

Place fan on top of the assembly.

Make a slot for the mains wire.

Remove the fan from the assembly before cutting the slot.

Place fan back on top of the assembly, centring the fan in the cylindrical mount.



Step 2.11:

Tape along bottom of fan cage to cylinder.

Ensure no gaps by sealing halfway up the fan cage.

Tape over the join between the front and back halves of the fan cage to minimise vibration.



Step 2.12 (End of basic filter box build):

Mark the build date of the assembly where it is clearly visible so that the age of the filters is known. Indicate a max 'replace by' date for the filters if donating the unit after assembly.



ASSEMBLY GUIDE

3. Fan start-up check

Step 3.1: Mandatory start up check

Set it to speed 1 and power on.

Run for minimum of half an hour to allow the motor bearing and electrical system to heat up and settle.

Do not leave fan running unattended during this initial period.

Switch off immediately and replace with another if:

- **Any evidence of an electrical burning smell.** It may be possible to smell the bearing oil within the motor. This will smell more like engine oil and dissipate in the first few hours of running. Whereas an electrical fault will smell like burning and will persist when the fan is turned off.
- **Any irregular rattling sound, like pieces of loose metal moving around.** As it can indicate metal contamination inside the motor or something loose inside the fan cage. The only noise coming from the fan should be linked to its rotation and of a regular rhythmic and low level.
- **If the fan vibrates the assembly violently side to side,** blades may be dangerously unbalanced. Some minor vibration is expected and can be felt when touched, but it should not large enough to visibly wobble the assembly side to side when checked by eye.
- **Fan noise should decrease over time** as the motor warms up and its internal bearing beds in and internal friction reduces. **A significant and obvious increase in noise level during initial half hour period may indicate a fault.** If unsure if noise has increased, it is probably ok.

If any of the above checks fail, replace with a new fan and return the fan as potentially faulty to the supplier. Failure to perform a basic initial start up functional check may result in premature air purifier failure or dangerous operation.

If uncomfortable, constant, high frequency ringing sounds are experienced after bedding in period, take the fan front cage grill off again and repeat steps 1.5 to 1.7. Additional duct tape wrapped tightly around the fan cage perimeter can help dampen high frequency ringing.

This noise level should further reduce over the initial first 24 hours of running. With the greatest change within the initial half hour period. Ensure the assembly has had a minimum of 24 hours running on minimum setting before any judgements regarding sound output acceptability are made in situ.

If providing bulk components to others to build with, it is advisable that someone with a basic level of experience and knowledge with electronics carries out these checks ahead of time for each fan.

Or supervises teams of others when carrying out these initial checks.

E.g. Electricians, caretakers, facilities staff, STEM teachers, etc.

Note: dangerous failure is unlikely due to EN 60335-2-80 motor protection regulations for this type of fan.

The background of the page features a repeating pattern of stylized, light gray tornadoes. Each tornado is depicted with a wide, funnel-like top that tapers towards the bottom, where it appears to be touching down or creating a small cloud. These tornadoes are arranged in a grid that follows a checkerboard pattern, alternating with light gray squares and white squares. The overall effect is a subtle, textured background.

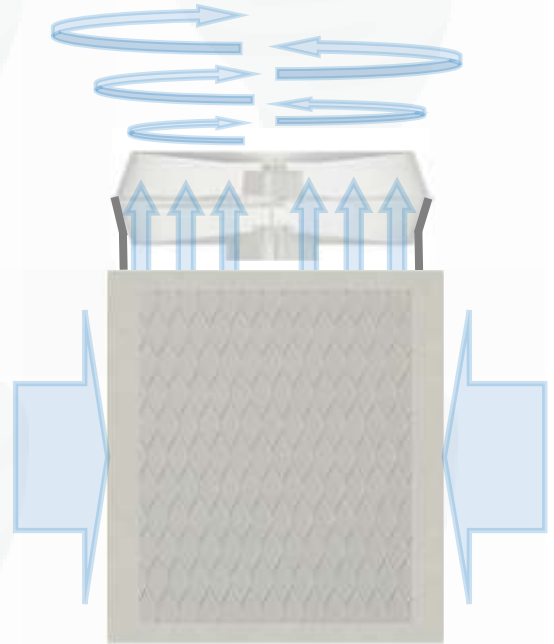
USE & MAINTENACE GUIDE

USE & MAINTENANCE GUIDE

4. Placement and Mains power

Placement

- The fan should point upwards, with filters on the sides as shown.
- Central placement as close to room occupants is ideal. Avoid placing in a corner, or far away from room occupants.
- The high flowrate and air circulation of this concept means placement is less critical than lower flow retail air cleaners.
- Ensure at least 15 cm (6 inches) of space between the filters and any walls or vertical surfaces. If not the flowrate will decrease.



Mains power

- **DO NOT RUN DIY AIR CLEANERS UNSUPERVISED.**
- To maximise filter and fan lifespan, turn off the DIY air cleaner when not required. E.g. when a space is unoccupied.
- Timer plugs can be used to automate turning on and off a DIY air cleaner so that it only filters during scheduled occupation of a space.
- Circulator cage fans typically have short mains wires. Try to place the unit near a mains socket.
- Access to a mains socket switch is required to turn the unit on and off because fan controls are not accessible (unless using speed control optional upgrade).
- If mains switch is not accessible then use of an extension cord with built in switch is required to provide an accessible power switch to turn the DIY air cleaner on and off. (E.g. J Electro power strip or similar.)
- Wiring can present a significant trip hazard depending on placement. Keep away from walkways, carry out a risk assessment if used in a non residential setting to assess if measures to minimise a trip hazard such as a high viz cord channel are required.



USE & MAINTENACE GUIDE

5. Maintenance Schedule

Filter replacement: 3—6 months

To maintain optimal filter performance, raise the assembly off the floor and use a mesh prefilter. replacing filters every 3 months according to manufacturer specification for Filtrete MPR 1900.

The filters can be used longer, but filtration efficiency of electret filters decays by up to 50% of initial performance over time. Eventually dust loading of the filter may start to compensate for the loss of electret charge leading to some recovery of filtration performance.

If this value is seen as too conservative, then 75% of initial performance can be assumed as a balance between an abundance of caution and not assuming that performance will remain perfect for the entire 6 months.

Left unchecked, these filters will eventually become so heavily caked with dust that that they deform, tear and become a source of pollution. Putting additional stress on the fan motor which in turn leads to accelerating fan wear and tear.

Hence, it is advised that filters are changed at 6 months absolute maximum, with the understanding that filtration effectiveness and CADR will start to drop significantly after 3 months.

If longer than 3 month filter change out is to be used, ensure that end of life performance is used when specifying the number of units needed for a desired space occupancy .

The use of a higher grade G3 prefilter is advised in areas with high levels of pollution or dust particles, such as near heavy traffic or in a workshop when sanding or spray painting takes place. G3 prefilters will decrease flowrate and hence CADR by approximately 10%.

Personal Protective Equipment

Wear gloves and a mask when replacing filters. Change clothes after replacing filters.

Why is this advised? Filters accumulate various unknown contaminants by design. These can be transferred to other surfaces and into the air when disturbed during replacement.

USE & MAINTENANCE GUIDE

5. Maintenance Schedule

Fan cleaning: Same frequency as filter replacement

Turn off then unplug the fan from mains supply. Remove the front cage.

Clean the fan blades, cage and motor housing of any dust build up at the same time as changing filters.

Failure to do so can lead to unbalanced fan blades, inefficient noisy operation over time and early failure of the fan.

Check the mains wire and plug for damage due to wear and tear in the environment.

PAT test periodically as required by organisational rules for non new electrical equipment.

Fan replacement or full service: - Annual

Comfort circulator cage fans are not typically designed for years of continuous operation.

Expect to need to replace the entire fan unit every year.

Alternatively the motor bearing and internal assembly can inspected, cleaned and re oiled by someone familiar in carrying out complex repairs on electro mechanical systems.

Guides as to how this can be done are found on the JordunU YouTube channel:

<https://www.youtube.com/playlist?list=PLHG6TiXOARcMG2BdyUaOt6AdebQfgstrd>

Failure to replace or service annually will lead to increasing noise, power usage, lower flowrate. Eventually jamming and triggering internal thermal overload protections.

How to check fan bearings

An indication of lack of lubrication can be ascertained by removing the fans front cage and spinning the blades by hand. Ensure the fan is disconnected from mains before removing the cage.

The blades should spin freely for multiple rotations without additional force applied. If they come to stop quickly after gently pushing the blades, it could be an indication of high internal friction caused by lack of lubrication or by contamination inside the bearing from dust build up.

The background of the slide features a 4x3 grid of 12 faint, stylized tornado icons. Each icon is a light gray, funnel-shaped vortex with a wider top and a narrower base, sitting on a small, cloud-like base. The icons are arranged in four rows and three columns, with a small gap between them.

OPTIONAL UPGRADES

OPTIONAL UPGRADES

6. Speed control access

Step 6.1:

Access to the controls is optional if using a mains extension lead with a built in switch and setting a fixed speed.

Make a hole directly in front of the fan speed control buttons using scissors.

Push a marker pen through the hole.

Or something similarly cylindrical and too fat to fit through the fan cage gaps.

Use the pen as a lever to press the speed control buttons.

Tape over hole when not in use to prevent loss of CADR.



OPTIONAL UPGRADES

7. Filter box stand

Poor filter life without a prefilter and placed at floor level

Heavy contamination of Aerostar 1" pleated filters was observed during a 2 month trial of an early prototype.

Mostly dander and dust sucked up from the floor like a vacuum cleaner in a busy hallway near a main entrance. With contamination of the filter being greatest at the bottom 1/4 of the open filter area.



7.1 Raise off the floor

General advice to avoid this additional heavy contamination of the filters is to raise them off the floor slightly. The height isn't critical, so long as there is an airgap between the filters and the floor to minimise surface level dust from being sucked into the bottom 1/4 of the filter.

How this is achieved isn't too important, heavy books, strong pudding bowls, strong plastic cups, cardboard edge protectors are some examples shown below.

Whatever method you use, ensure the filter assembly cannot topple easily. E.g. if someone falls onto the filter box during use.



OPTIONAL UPGRADES

8. Prefilter: Insect mesh

8.1 Mesh prefilter advice

The use of a prefilter is important for maximising filter life due to ingress of hairs and large dander.

Without a prefilter, CADR flowrate can drop before filter change period has expired due to dander build up on the filter surface.

It is highly recommended that the use of a fine mesh prefilter screen is used in any spaces where pet dander (hairs) is present or occupancy levels are high.



8.2 Mesh prefilter materials

Anti tamper (Top): Reinforced fibreglass mesh.

Fire resistant, non stretchable, difficult to tear by pets or children

Standard (Bottom): Nylon insect mesh.

Stretchable and easily torn. Sufficient as a coarse prefilter.



8.3 Mesh prefilter attachment

Duct tape will struggle to grip mesh.

Some alternative attachment methods that allow removal for periodic vacuum cleaning are:

- Velcro tape (Best)
- 20mm sewing elastic strap (Simple)
- Roll and zip tie ends of mesh together
- Magnetic tape (expensive)

Katy McConway @KatyMcConway - Dec 24
I think I've improved the pre-filter though: unlike insect netting attached with sticky-backed velcro, the elastic strap sticks to the box, the hooks strip with the backing left in place and pressed through 2 layers of felt to hold it in place.
Extra cost of the elastic = \$15



OPTIONAL UPGRADES

9. Prefilter: G3 / Wadding / Carbon

9.1 G3, Carbon and 40z fire resistant wadding prefilter

Additional more aggressive prefilters can be added to protect the filters for use in environments with high levels of dust e.g. workshops, near building works, areas of high traffic pollution.

G3 can be purchased by the roll in bulk to keep costs low, another alternative is to use 40z fire resistant furniture wadding which can often be sourced at lower cost and will be sufficient to catch larger dust particles.

Prefilters with built in activated carbon can also be used to help reduce Volatile Organic Compounds (VOCs) that standard particle filters have no effect on. Additional reduction in particle CADR performance is likely to result from additional resistance to flowrate of a dense carbon layer.

A length of about 2.3m per filter assembly is required. At a height of approximately 0.63m (630mm).

To avoid the prefilter from being torn in use an additional layer of nylon insect mesh on top is advised.

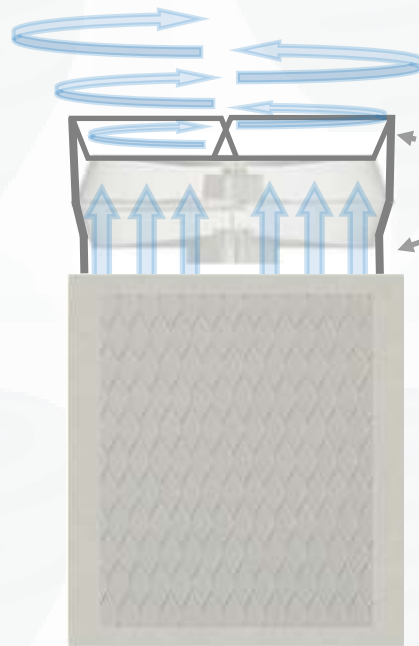
Curl up the ends and tie. Wrap around the assembly and tie the ends together with zip ties to secure

Example of contamination from brick dust turning filters light pink within hours of building works commencing.



OPTIONAL UPGRADES

10. Fan outlet tube & swirl vane



**Tube cylinder
at fan inlet & outlet**

Guides flow through fan,
further improving efficiency,
higher pressure,
higher flowrate

Step 10.1:

Add another cylinder on top using the remaining Correx offcuts described in Steps 2.7 & 2.8

This will offer some additional guarding, guide the flow vertically and boost the flowrate.



Step 10.2:

Seal the gap between the top and bottom tubes.

Ensure the tape is pulled tight with at least 2 layers.

This will dampen noise that results from the cage vibrating.



OPTIONAL UPGRADES

10. Fan outlet tube & swirl vane

Step 10.3:

Mark up 6 off 50mm x 250mm rectangles of Correx or thick cardboard.

Cut the rectangles of Correx along the lines of corrugation so they do not kink.



Step 10.4:

Trim a little off the ends to ensure they are relatively straight.

Need to be slightly less than 1/2 the fan cage or tube diameter.

Tape along both edges to create a smooth surface for flow to pass over.



Step 10.5:

Cut small notches in one end of 2 of the swirl vane blades.

Place first two at top of the fan, using notches to hold together.

If they bow from being too long, trim down few mm at a time until achieve a good fit.

Use small strips of tape to pin in place at either end, ready for next step.



OPTIONAL UPGRADES

10. Fan outlet tube & swirl vane

Step 10.6:

Use scissors or screwdriver to make holes in positions either end as shown.



Step 10.7:

Use zip ties to secure in place at edge of the cylinder as shown.

Very important to ensure the tie is cut flush.

Use electrical side cutters or craft knife to trim until no sharp edge remains on the tie.



OPTIONAL UPGRADES

10. Fan outlet tube & swirl vane

Step 10.8:

Now that the first two swirl vane blades are secure, the others should stay put using only duct tape.

If any bow out due to tension from being too long, trim the ends down until they fit.

Secure with strips of duct tape either end.

Add more strips of tape as necessary to secure long term.

If any swirl vane blades feel loose then can secure with ties as with the initial 2 fitted.

Ensure blade angle is 30-40° from horizontal. By eye is fine.



OPTIONAL UPGRADES

11. Anti-tamper Metal Meshes

If high strength anti tamper covers are required for safety critical applications the following options to protect the filter surface have been identified.

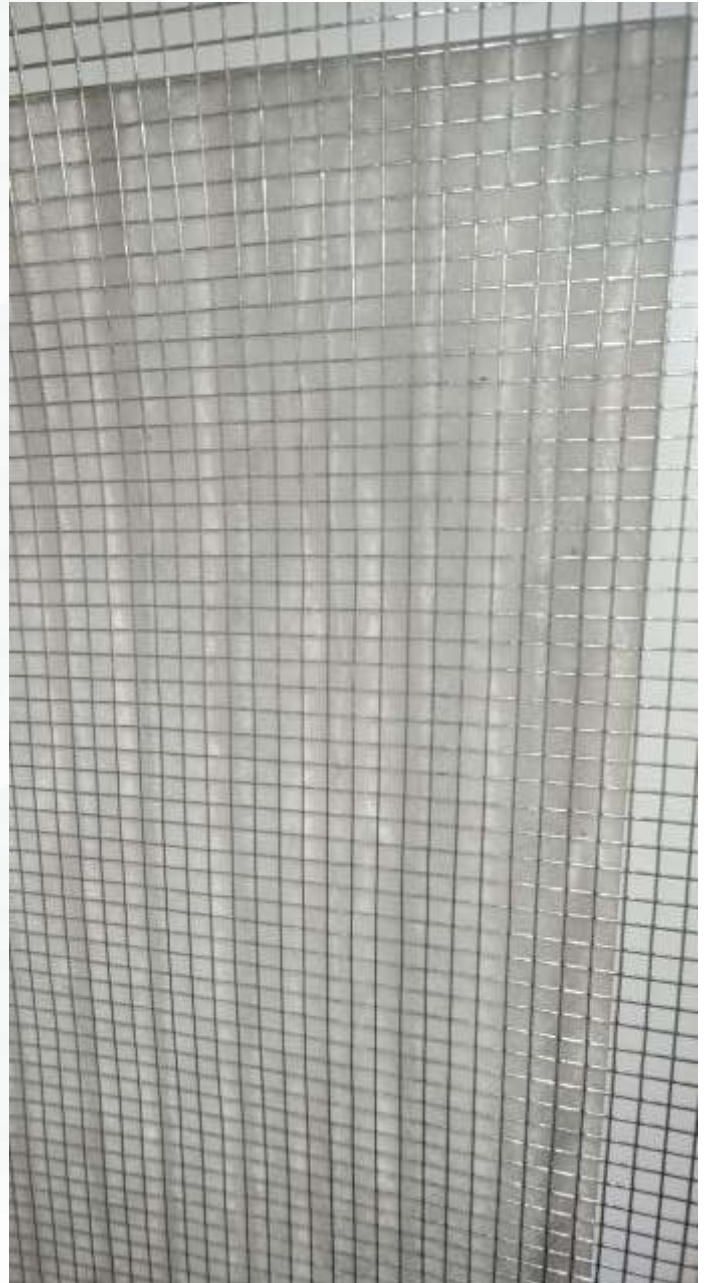
Aluminium Modelling Mesh (500mm wide)

- + Low cost, easily formed and cut to size with craft blade. Comes in 500mm same as 20" panel widths.
- Deforms / tears with high impact force. Ok anti touch and pre filter screen but wont resist sharp objects.

Rodent mesh / Chicken wire / woven wire / welded mesh

Look for 6mm or less mesh spacing. 4mm Ideally.

- + High strength and durability.
- High cost, typically sized for ventilation ports not wide panels, hence difficult to source appropriate sizes.



OPTIONAL UPGRADES

12. Reinforcement frame / Anti-tamper enclosure

A basic safety enclosure to prevent access to the fan grill can be constructed quickly and easily using cardboard edge protectors.

This option is as a direct result of feedback from field testing of a prototype in a school setting.

Step 11.1:

Use 4 x cardboard edge protectors.

They can be converted into stilts by adding another 100mm length of cardboard edge to the bottom.



Step 11.2:

Enclose the fan outlet as shown, using either Correx, thick cardboard or fibreglass mesh attached with zip ties.

If using Mesh, brace the assembly across the top horizontally as shown.



OPTIONAL UPGRADES

13. Acoustic damping

The default fan and filter combination chosen should result in a low noise output of 50dBA, as a white noise, free of irritating pulsating noises (resonance).

This should be sufficient to not cause a significant disturbance in most environments.

However, if additional noise suppression is required, acoustic baffles can be mounted between the assembly and the occupied space.

Heavy beach towels or similar, attached at top of an enclosure frame work best. By hanging loose they absorb and reflect some of the low frequency sound.

This technique is capable of lowering the noise observed at 1m from the assembly to below 48 dBA during testing.



The use of a Correx or cardboard enclosure around the fan can act like a drum skin, transmitting flow noise to the environment. Increasing the level of perceived noise emissions. If this is the case, the use of mesh fan enclosure is advised.

Note: Minimum noise levels will take a couple of hours to be achieved with a new fan as its motor and bearing take time to wear in.

With an fan that has already been run in, minimum noise levels may not be achieved until at least 15 minutes from a cold start.

Alternatively, a dense fire resistant fabric could be placed between the fan and the inside of the enclosure to act as a padded silencer box.

