HEPA filter flowhood

original source: http://www.fungifun.org/English/Flowhood

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Why you need one

A laminar flow hood is a piece of equipment which makes sterile working procedures in mushroom cultivation easier and reliable.

A flow hood consists of a coarse pre-filter, a blower and a very fine filter (the so called HEPA (High Efficiency Particulate Air) filter which filters particles from the air to a high degree.

This makes the air coming out of the HEPA filter nearly sterile which allows doing transfers in this stream of sterile air without worrying about contaminants entering from the air and contaminating the cultures.

Getting started

You should begin the construction by selecting a HEPA filter and a blower.

The HEPA filter size depends on how big you want to have your working space. The smallest filter size you can reasonably use (for home scale cultivation) is 1ft x 1ft, better though 1ft x 2ft or 2ft x 2ft if you are going to inoculate filter bags.

Sources for HEPA filters

www.aafeurope.com
(Austria, Belgium, Bosnia & Hercegovina, Bulgaria, Canada, China, Croatia, Czech Republic, Finland, France, Germany, Great Britain & Eire, Greece, Hungary, India, Italy, Luxembourg, Malaysia, Mexico, Middle-East, Netherlands, Saudi Arabia, Serbia, Singapore, Slovakia, Slovenia, South Africa, Spain, Taiwan, Turkey, United Arab Emirates (UAE), USA)

www.filtrationgroup.com
(Australia, Austria, Belgium, Brazil, Canada, China, Columbia, Costa Rica, Denmark, Egypt, France, Germany, Great Britian, India, Indonesia, Italy, Japan, Malaysia, Mexico, Netherlands, New Zealand, Norway, Philippines, Puerto Rico, Republic of Korea, Russia, South Africa, Spain, Sweden, Thailand, Turkey, United Arab Emirates (UAE), Ukraine, USA)

www.camfilfarr.com
(Australia, Austria, Belgium, Brasil, Canada, China, Danmark, Deutschland, España, France, Ireland, Italia, Malaysia, Netherlands, New Zealand, Polska, Schweiz, Singapore, Suomi, Sverige, United Kingdom, USA)

Australia
www.austair.com.au
www.aesenvironmental.com.au
www.biocabinets.com.au
www.hotfrog.com.au/Products/HEPA-filters

Austria
www.czech.at
www.vokesair.at

Bulgaria
www.eviss.bg

Canada
www.thefiltershop.com
www.tridim.ca

Czech republic
www.elfa-aaf.cz
www.filco.cz
ks-klima-service.czechtrade.us

Denmark
www.industrifilter.dk

France
www.aaf-sa.fr
www.climavent.fr

Germany
www.aaf-lufttechnik.de
www.atex-filter.de
www.camfil.de
www.cleanroom.de
www.luftfilterbau.de
www.euro-filter.de
www.filtega.de
www.het-filter.de
www.reinraum.de
www.spxairfiltration.eu
www.wieninger-filter.de
Filtertechnik-Deutschland

India
www.aeromechindia.com
www.multilab.biz

Israel
www.filt-air.com

Italy
www.altifilter.com
www.defil.it
www.eurofiltri.com
www.fcr.it
www.ma-in.com
www.mcleodrussel.it

Netherlands
www.mcleodrussel.nl

Norway
www.aafluftfilter.no

Russia
www.enveron.ru
www.ftov.ru

Slovenia
www.ecotip.si
www.hidria-imp-klima.si

Sweden
www.scandfilter.se

Switzerland
www.logicair.ch
www.sit.ch
www.tecnofil.ch
www.unifil.ch
www.vokes-air.ch
www.trion-elektrofilter.ch
www.wesco.ch

Turkey
www.aaf.com.tr
www.boytem.net
www.tekfil.com

United Kingdom (UK)
www.hepa.co.uk

USA
www.aafilters.com
www.airexco.com
www.airflotek.com
www.appliedairtechnology.com
www.cambridgefilterusa.com
www.cepatest.com
www.filtera-b2b.com
www.filterservicesil.com
www.fungi.com
www.hepa.com
www.hepafilters.com
www.laminaire.com
www.lascoservices.com
www.techrite.com
www.tridim.com
USA Filter search web site

Yugoslavia
www.interfilter.co.yu

Match a blower to the filter

Once you decided on the size of the HEPA filter, you have to match a suitable blower to this particular filter. This is a very important step, so make sure to study the directions thoroughly.

Every filter has a "resistance" when air blows through it at a certain speed, this resistance is called the "static pressure".

Press your hand against your mouth. Now try to blow through it. Dependant on how firm you press it against your mouth, you will have some difficulties blowing air out and you will feel some resistance, this is the static pressure.

Every filter has a different static pressure at the working point. The working point is where the amount of the air flowing through the filter is sufficient to meet the requirement of the laminar flow.

The static pressure is expressed in inch of water column in the English units, a typical value would be 1", the SI unit for pressure is Pa(Pascal).

1" water column is around 250 Pa. Each filter has a data sheet (consult the manufacturer if this is not the case

with your filter) where the static pressure at the working point is entered. Before the air enters the blower it is usually pre-filtered by a furnace filter around 1"(2.5cm) thick placed in front of the blower to protect it and the HEPA filter from big particles like dust and hairs. It can be assumed that the static pressure for this prefilter at the working point is around 0.2"(50 Pa).

According to Stamets (**Paul Stamets and J.S.Chilton: The Mushroom Cultivator** p. 347 ff) the air speed of the air flowing from the filter surface should be (at least) **100 feet per minute(fpm)**. (around 30 meter per minute or 0.5 meter per second). Determining the correct blower for a filter consists of several steps:

1. Find out the area of your filter by **multiplying the width and the hight** in feet (for instance the smallest reasonably usable filter would be 2ft x 1ft):
2ft x 1ft = 2 ft^2

2. Multiply the required air speed(the one Stamets specifies, 100 ft/min) with the area of your filter:
100 ft/min x 2 ft^2 = 200 ft^3/min

So 200 ft^3/min(= cfm = "cubic feet per minute") is the amount of air your blower must deliver **at the sum of the STATIC PRESSURE of the HEPA filter + prefilter**.

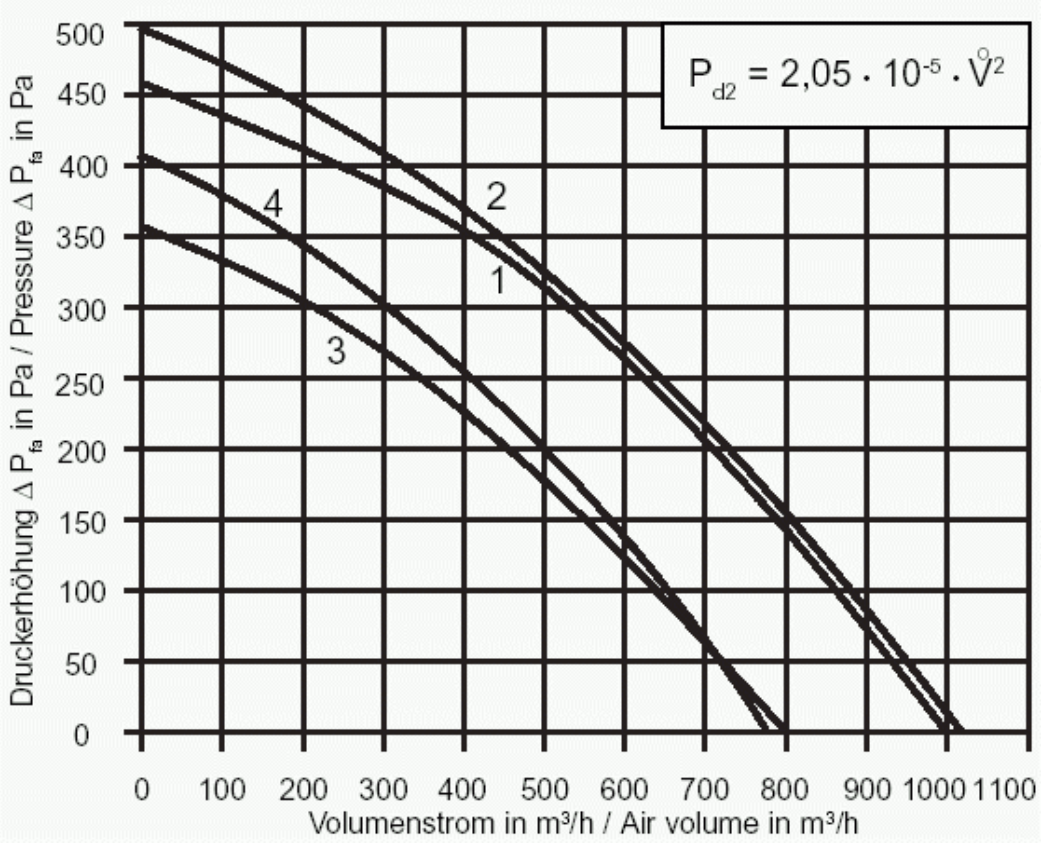
NOTE: 1 cfm= 1.7m^3/h

So if you use the above filter with 1"(250Pa) static pressure and a furnace prefilter with a static pressure of 0.2"(50Pa) your blower must deliver **200 cfm(340m^3/h) of air at a static pressure of 1.2"(300Pa).**

Finding the correct blower

Each blower has a data sheet (consult the manufacturer if this is not the case with your blower) where the correlation between the **volumetric flow** and the **static pressure** is represented by a graph or table.

Here is such a set of curves for 4 blowers (numbered 1-4).
NOTE: Each model of a blower has his own characteristic curve. This chart shows the curves for 4 different particular models of axial duct blowers.
What you can clearly see is that **the bigger the static pressure the less air the blower delivers**, up to the maximum static pressure where the air output is zero.



Sometimes these data are presented in form of a table.

Baugr. / Type	Volumenstrom V in m³/h bei statischer Druckerhöhung dpfa in Pa Air volume in m³/h at static pressure drop dpfa in Pa									
GC2	0 Pa	50 Pa	100 Pa	150 Pa	200 Pa	250 Pa	300 Pa	350 Pa	400 Pa	450 Pa
133E2	1080	1020	960	890	800	690	550	310	20	
146E2					920	860	750	625	415	150
181E4	1310	1190	1040	815	500					
195E4-A	1560	1415	1260	1060	800	400				
195E4-L	2100	1820	1700	1380	1000	500				
240E4-A			1910	1800	1660	1450	1000			
240E4-L	2800	2750	2600	2400	2200	1900	1080			
249E4-A	3200	3100	2900	2760	2600	2380	2150	1780		
249E4-L	3750	3600	3400	3200	3000	2740	2400	1900	250	
251E4-A	3600	3400	3250	3100	2900	2700	2400	2000	700	
251E4-L	4000	3780	3610	3400	3200	2800	2500	1950	1000	

By now you know how much your blower must deliver and at which static pressure. In our example it was 340m^3/h at 300Pa.
So what we do now is to go in this chart and find the value of 300Pa(**=1.2"**) at the vertical axis. Then you move to the right until you reach 340m^3/h (**=200cfm**).
Now, ideally there should be a curve of a blower going exactly trough this point, but this is not always the case.
So we have to choose a blower that best approximates our requirements.
In most cases we should choose a stronger blower, if it's not too strong.
How strong is too strong? I'd say the blower shouldn't deliver more that 20% more air than we calculated, so in our case the strongest acceptable blower would be around 400m^3/h.
In this example we have a blower that delivers 300m^3/h (according to our calculation it should deliver 340m^3/h though). This is a difference of mere 10%. The next stronger blower in this chart delivers 530m^3/h at 300Pa, which is way too much.

In this case we go for the smaller(and cheaper) blower (Nr.4) instead of the much bigger one (Nr.1, which

delivers 530m^3/h at 300Pa), despite the fact that it's generally recommended to take a stronger one.

NOTE: This chart is only an example for a set of 4 particular blowers. The curves of the blowers available to you may look a bit different, but similar.
Usually, if you search long enough, you will be able to find a blower that exactly matches your HEPA.

The design in this pictorial uses an in-line centrifugal fan, another good option (actually the one most commonly used for flow hoods) is a squirrel cage blower (also called shaded pole blower).

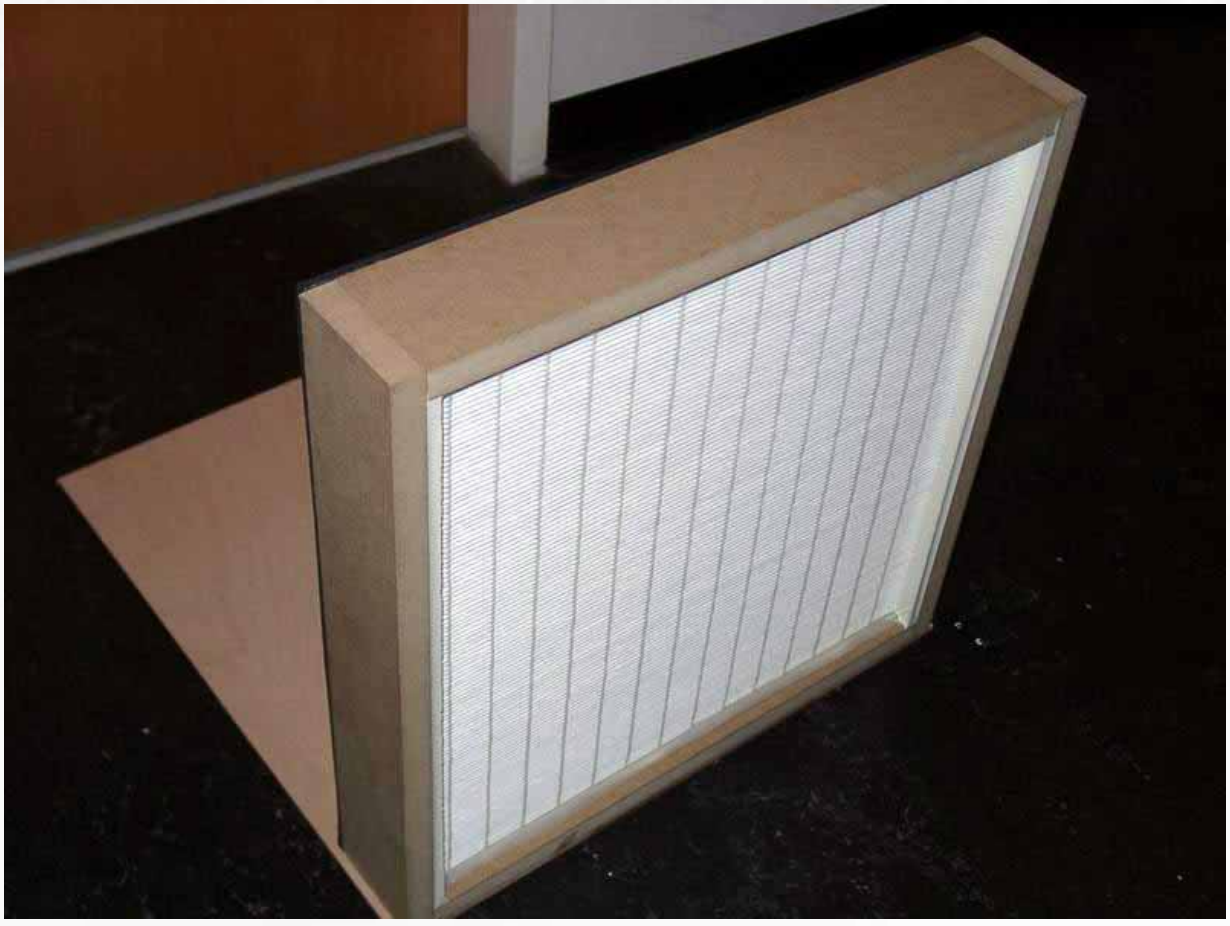
You can get many blowers at ebay.com, often at much cheaper prices than if you bought them directly.

Ebay offers
It is important to contact the seller in advance and inquire about the exact characteristics of the blower beforehand, so you don't end up with a too weak blower.

When in doubt, head for the more powerful blower, you can still regulate it down if necessary with a variable speed controller/regulator.

Construction of the hood

After you bought the HEPA filter and a matching blower, you have to get some materials for the construction of the box that will accommodate the above 2 components.
Basically you want to build a box, the front wall of the box will consist of the HEPA filter, and another wall will have the inlet of the blower with the pre-filter mounted. I had the material for the walls already cut to fit the size of the filter and the blower.
I begin by gluing and screwing the filter to the bottom wall.



Then I add the side walls...

...and the back wall.

The blower will be mounted so the inlet is at the top.

A hole is cut in the wall at the top to accommodate the blower inlet.

The blower rests on a bar mounted in the box. The white dots on the bar is some (already dried) silicone mass to provide some damping and lessens vibrations. All the joints are filled with silicone mass so the box is airtight.

The top with the blower is screwed on the box. The space around the opening and all other cracks in the box are tightened with silicone mass.

A pre filter is mounted atop of the blower. I use a furnace filter, you can also use other filers, like car air filters, just make sure they are large enough and that they don't have too much air resistance, otherwise you would need a larger blower.

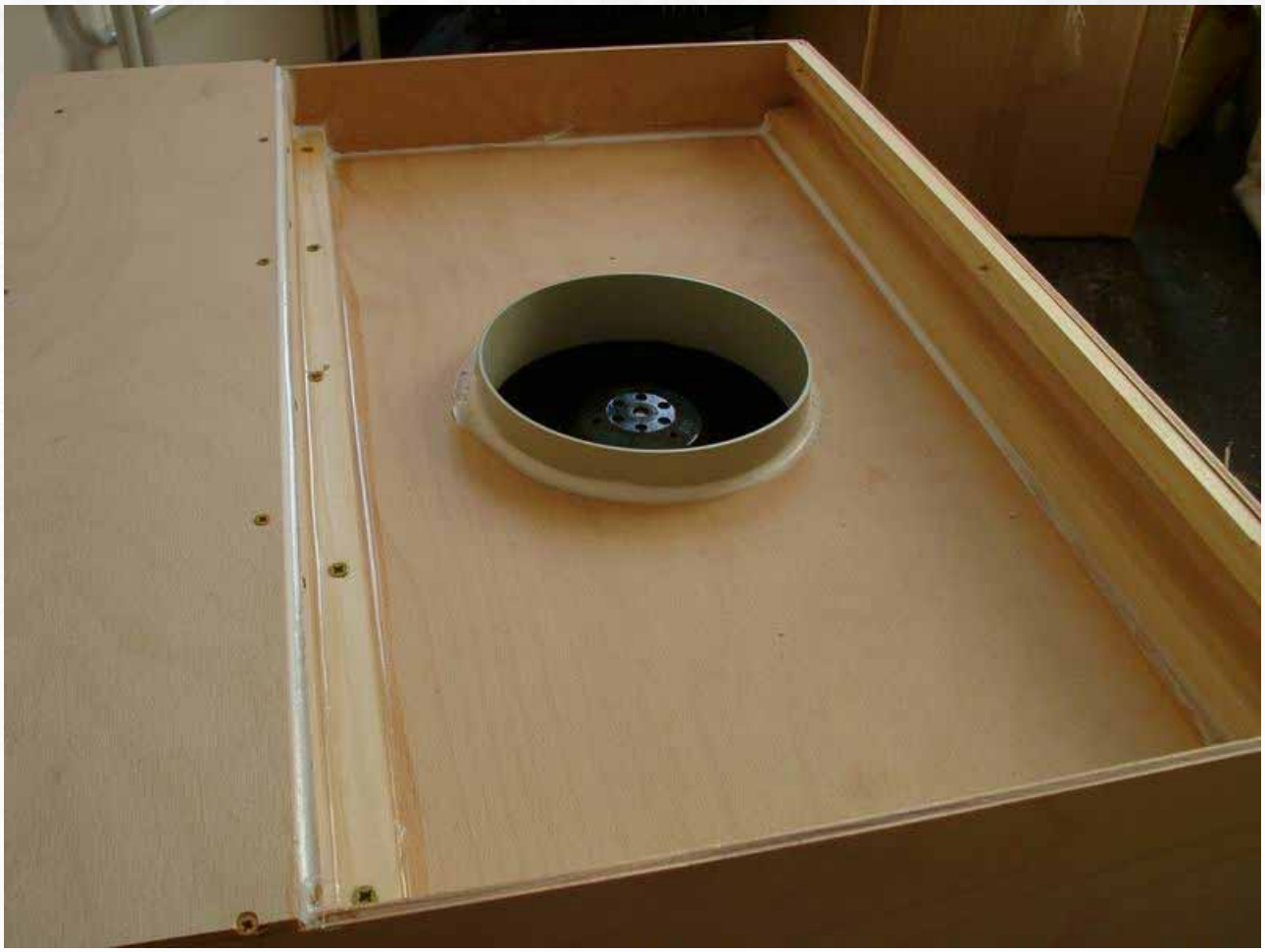
Detail of the pre-filter.

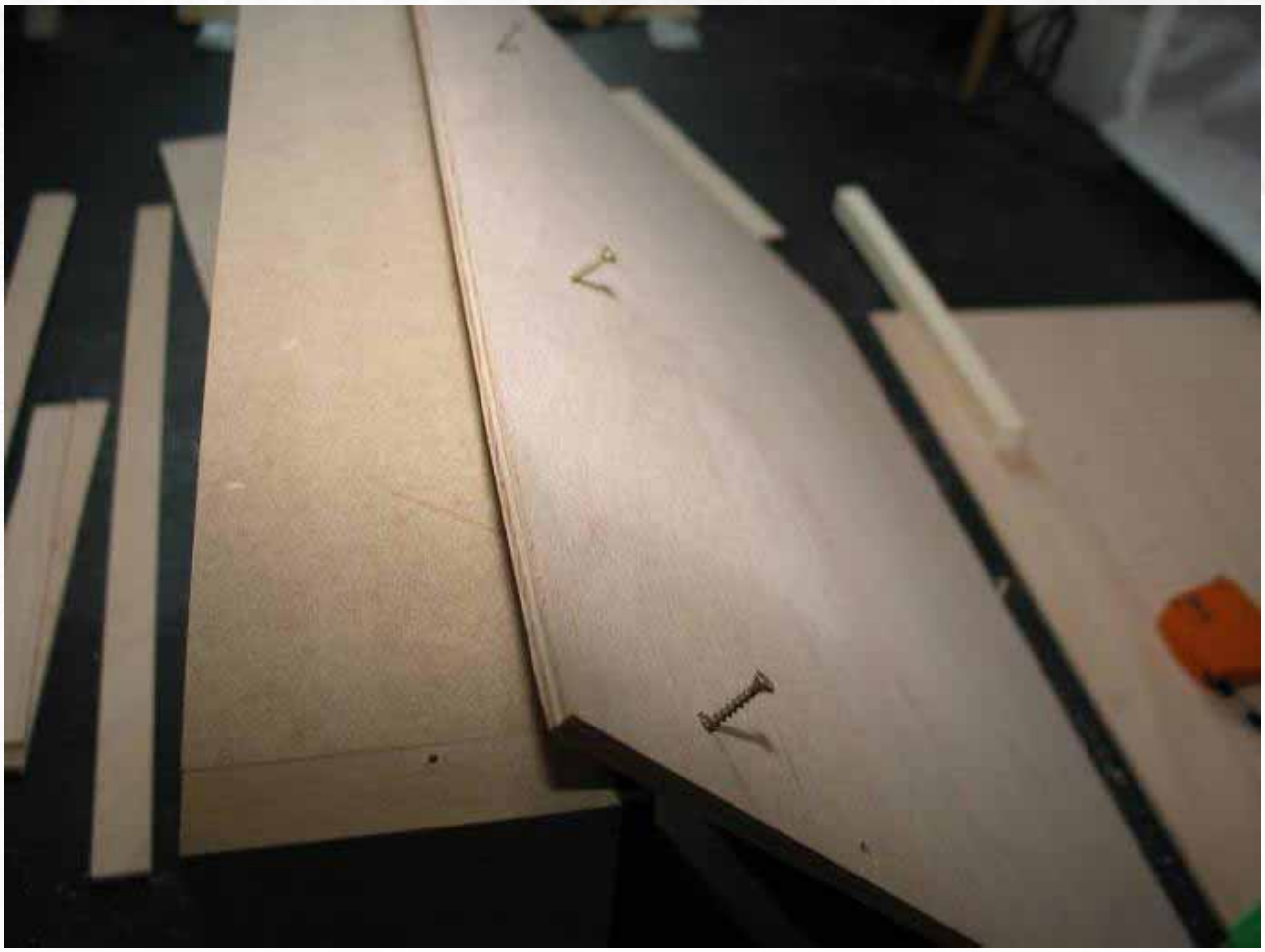
A net is tackered to the frame of the HEPA filter to prevent touching and harming the delicate filter.

The finished flow hood.

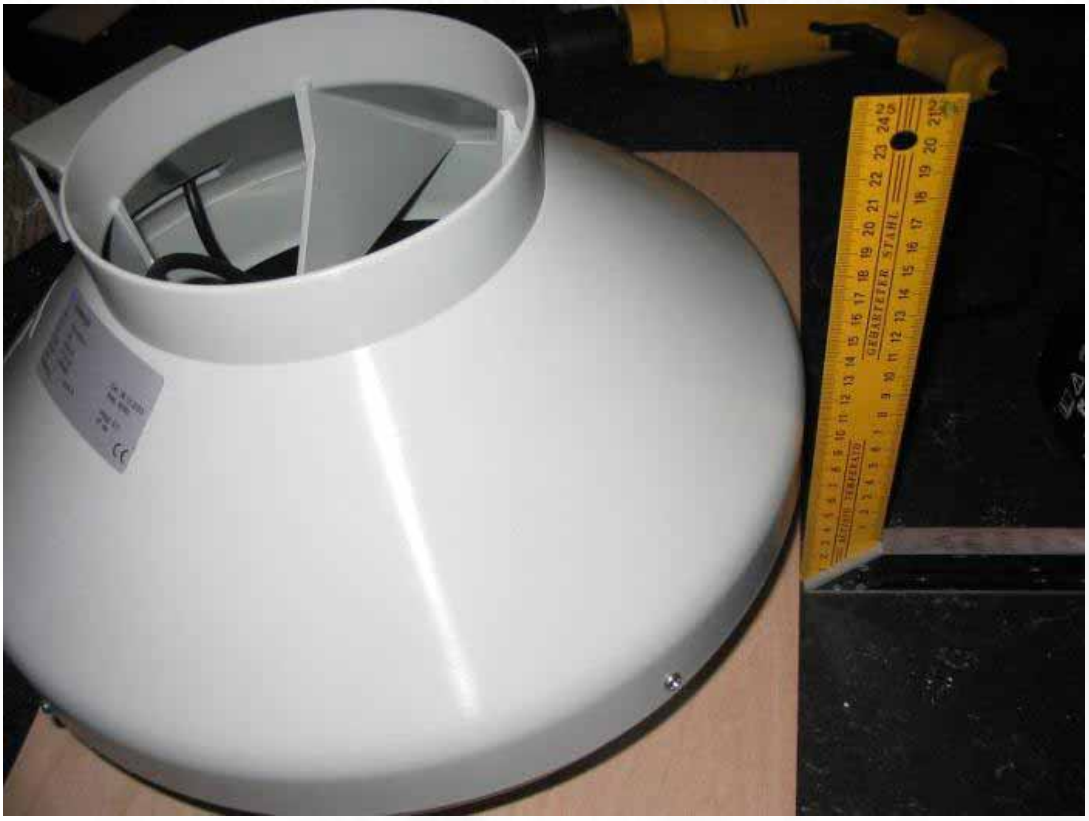
Some pictures of a similar design

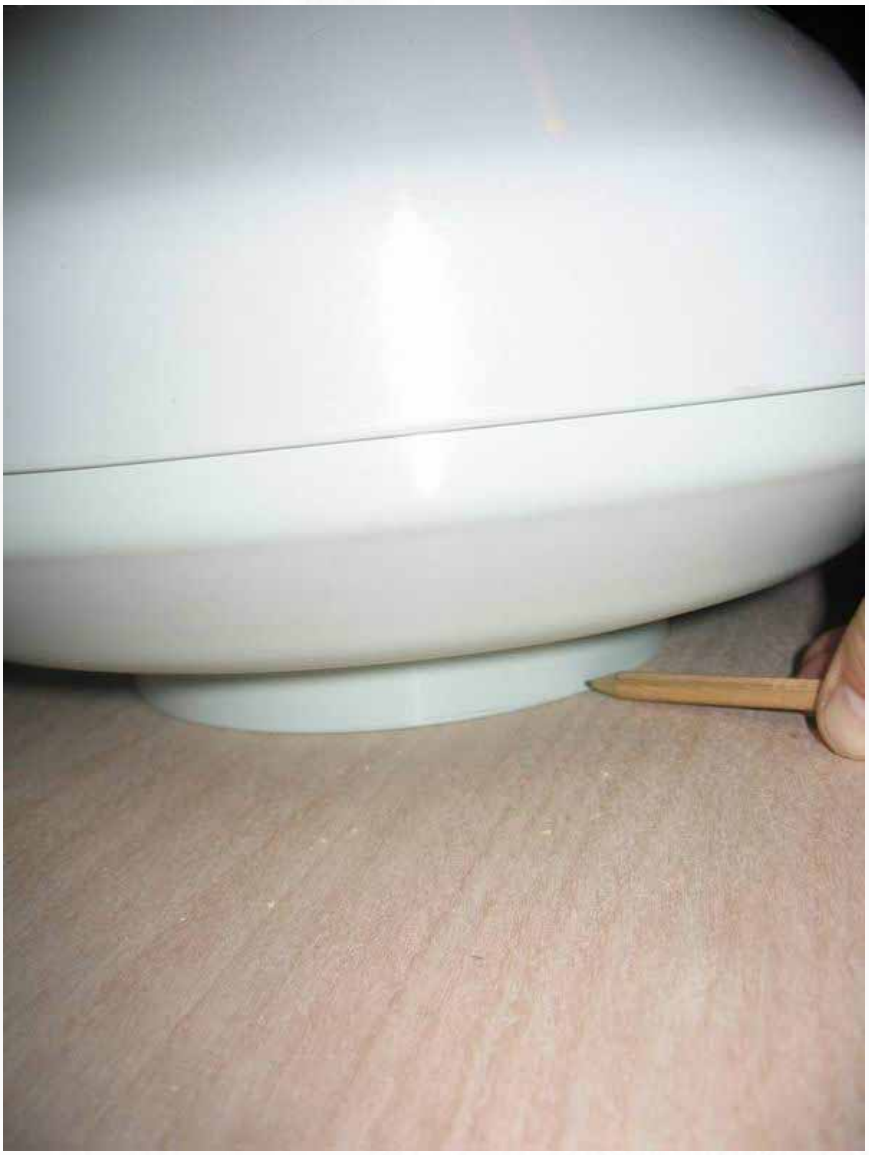
Some pictures of a similar design, the only difference is that the blower is mounted around 10 cm deeper, so the pre filer is in the same level as the rest of the box. Makes it more visually appealing and more compact this way.






Systemair


GEBRÜDER STAHL

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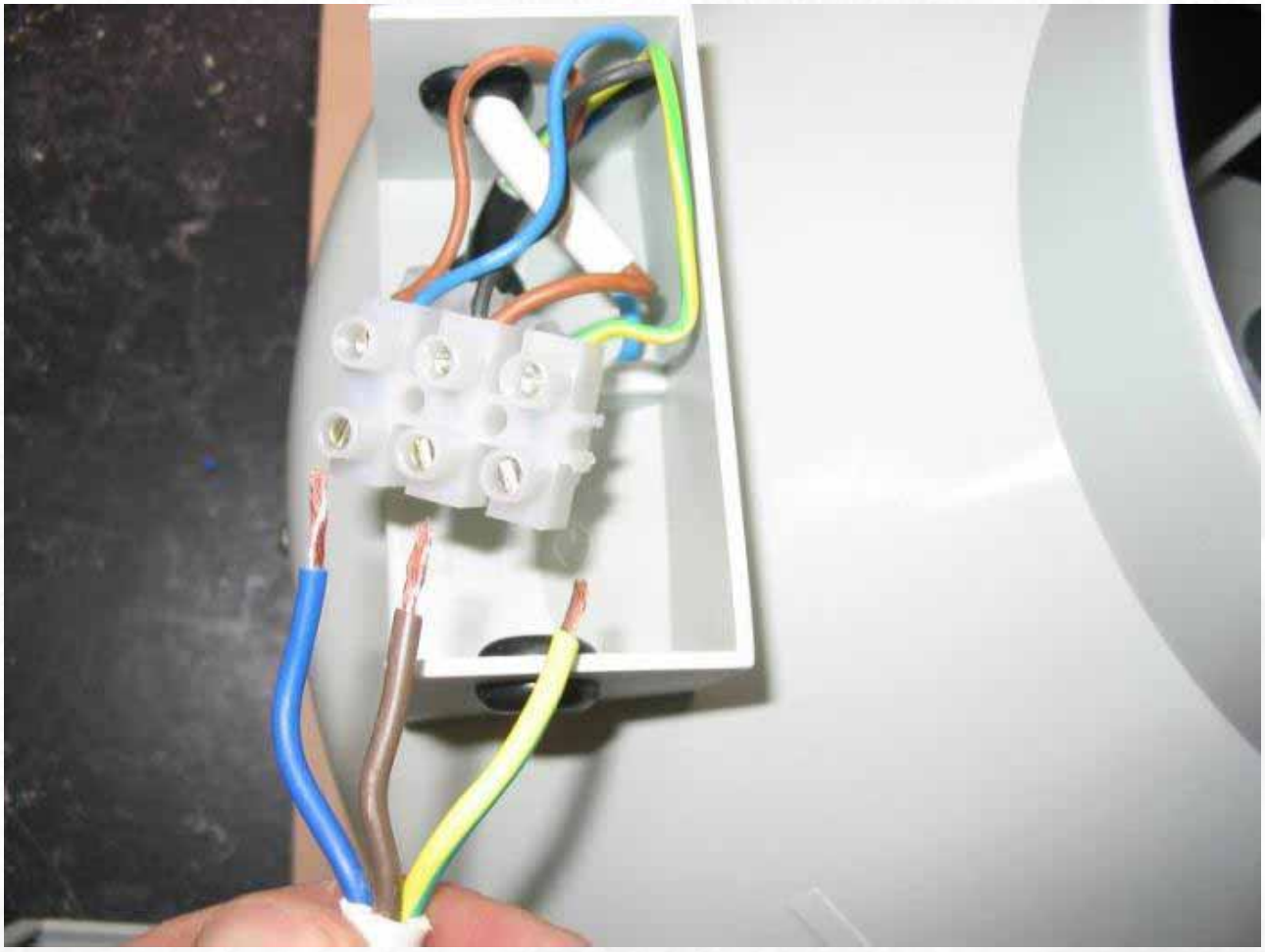

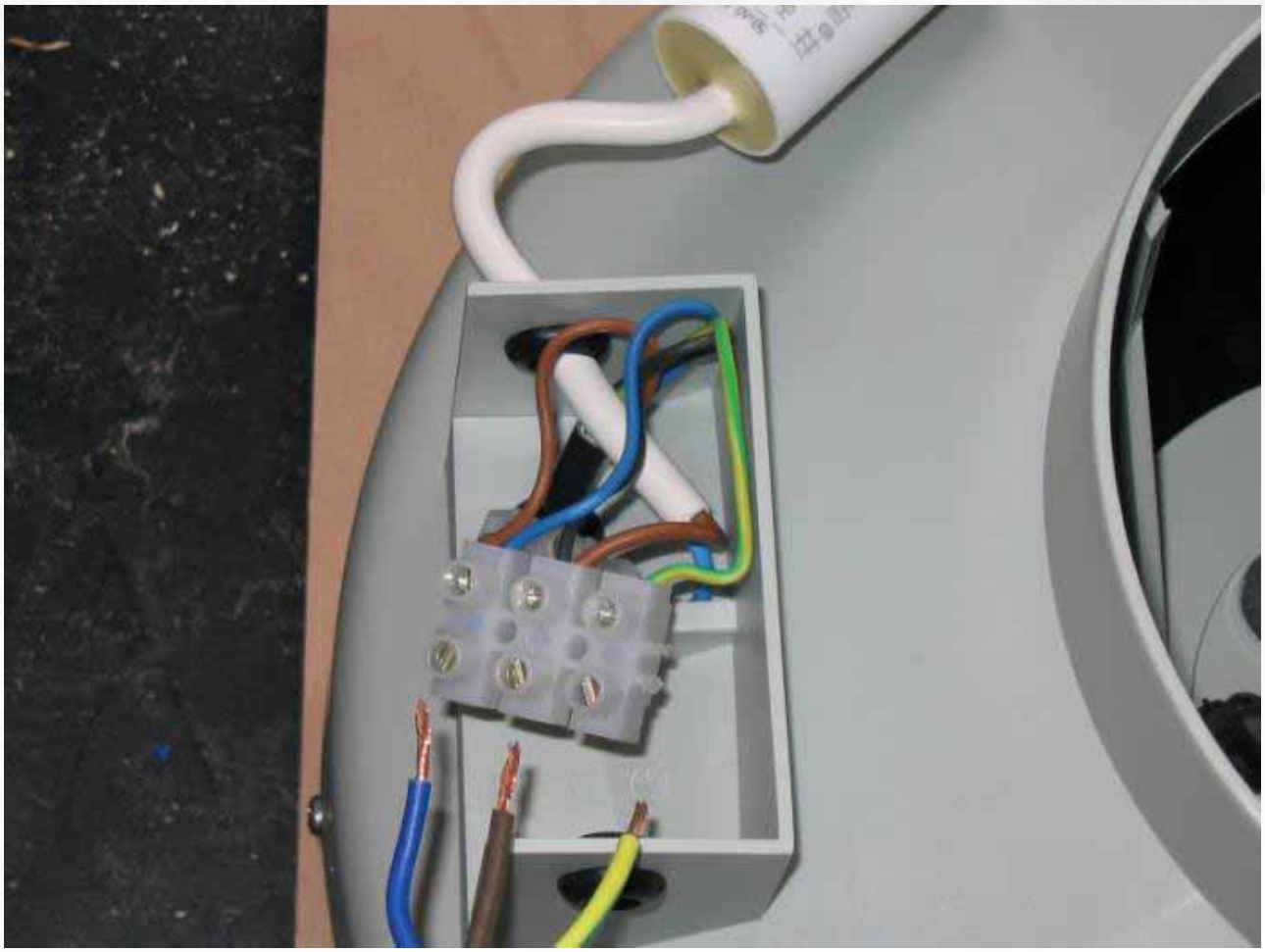

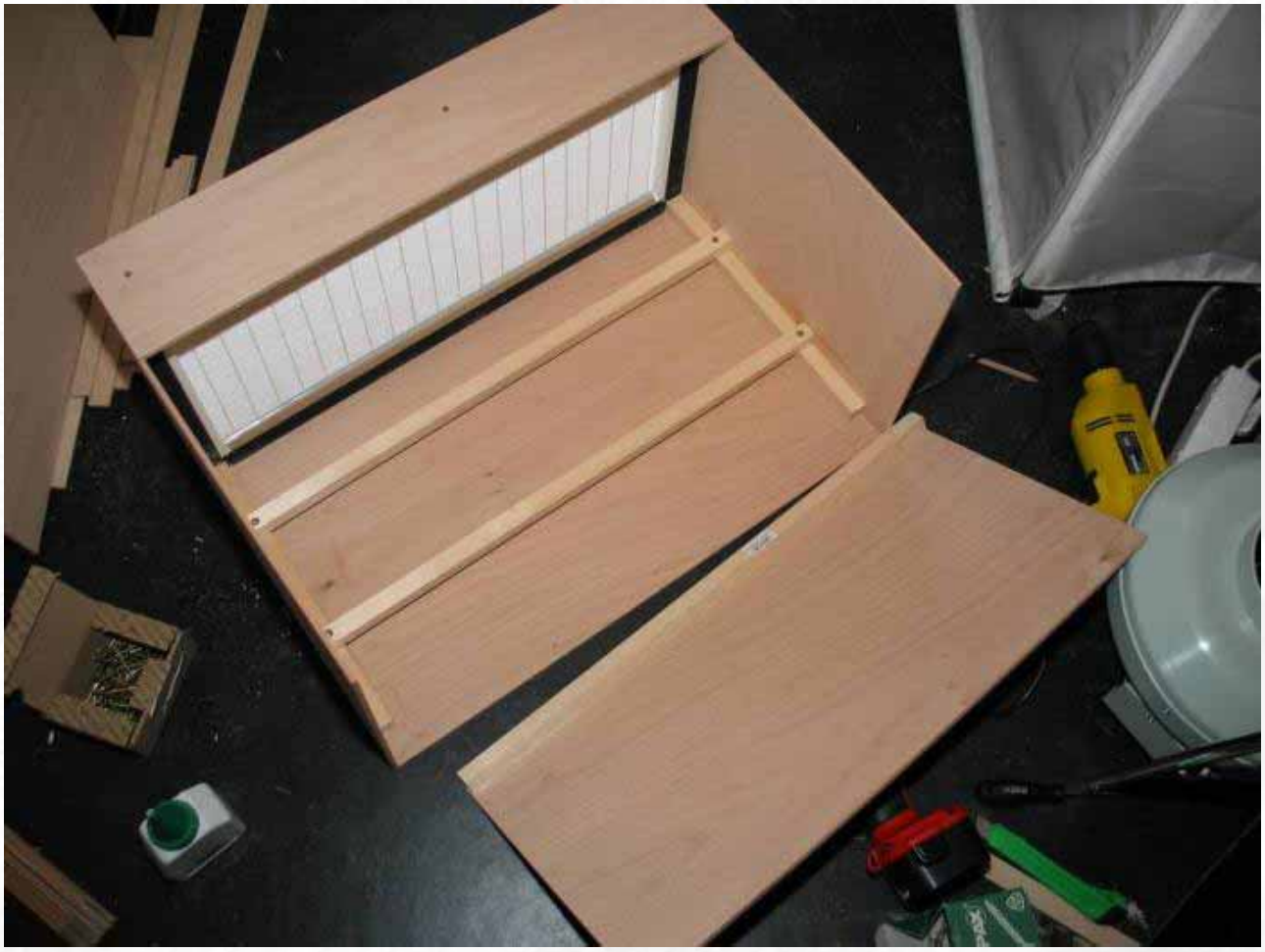

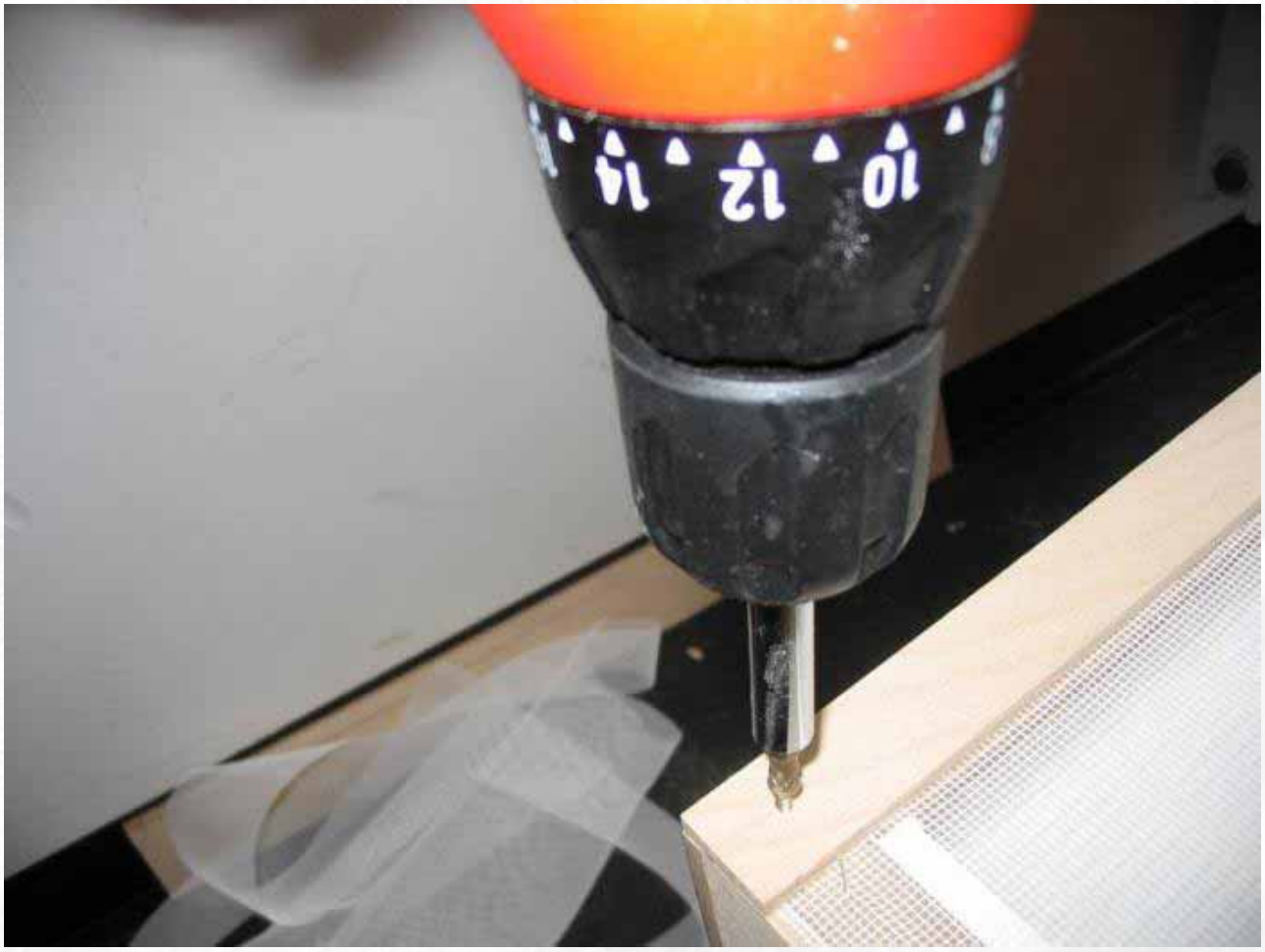
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12
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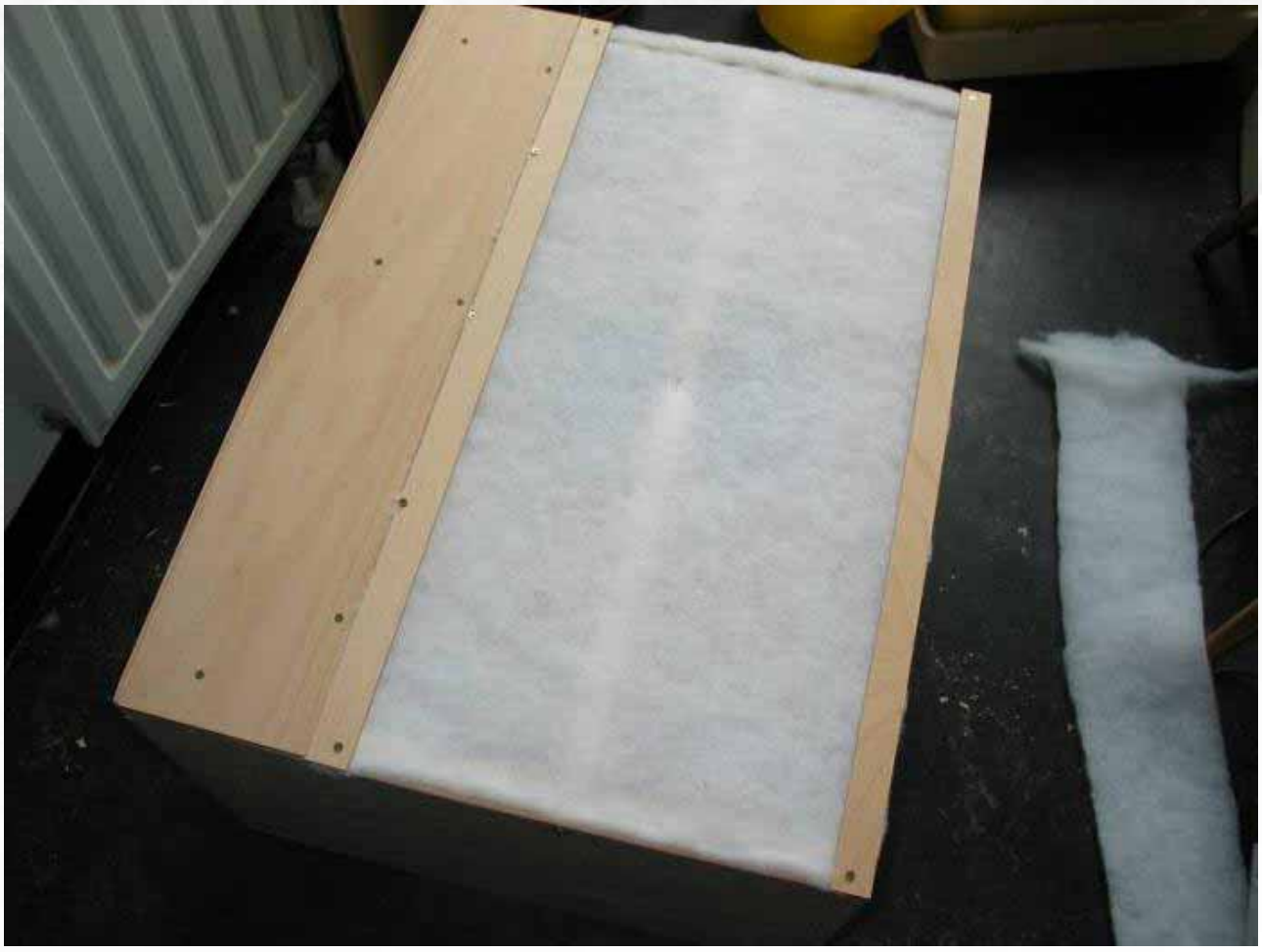


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