

Friday, February 01, 2008

Folding Wall-Hung¹ Spray Booth Chapter I: The Grand Plan

Dear long-suffering Shop Story recipients,

Brace yourselves. I'll be trying something a little different this time. Rather than show off the finished project and some of the steps that lead up to it, I'd like to document progress as I go, in separate installments. Since this is (for me anyway) a fairly major project, I need to approach it in manageable bytes...um, bites, or I'll never get started.

As always, you don't need to follow along unless you want to. If you do, and if you spot something obviously haywire with my approach, or just want to offer criticism or advice...please do speak up! I'm learning as I go on this one, and I will listen carefully to all your suggestions.

Rationale: I have somehow managed to convince myself² that I really do *need* a paint spray booth in my shop if I'm ever to finish several currently languishing model projects.³ The problem, of course, is that there is no obvious place in my overcrowded playroom to put such a bulky item.⁴

Concept: A wall-hung, folding booth seemed the answer. And indeed, there is one—and only one—relatively unoccupied stretch of wall available, on the west wall:



¹ Notice how well I resisted the temptation...

² Though probably not Dee. But she's being patient with me, as always.

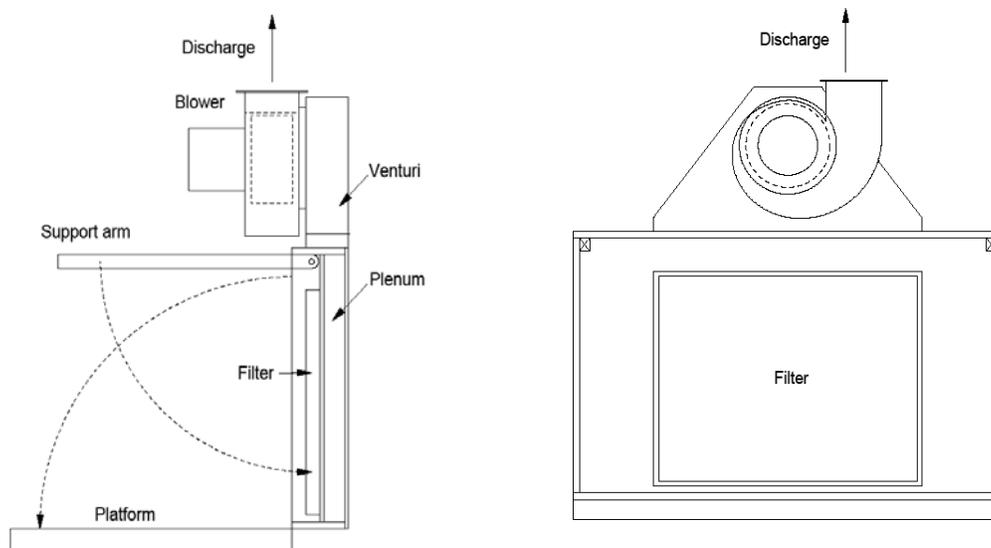
³ My boxcab locomotive is an example. It's been awaiting a trip to the paint shop for about two years now.

⁴ After perhaps 30 agonizing milliseconds of serious soul searching, I decided I couldn't possibly get rid of anything else to make way; I'd have to cram it in there somehow...

These are the requirements factored into the initial design concept:

1. Large enough when unfolded to accommodate “typical” projects
2. Adequate airflow to exhaust all paint mist and vapors
3. Exhaust outdoors
4. Adequate lighting of the subject
5. Very compact when folded, to avoid compromising chop saw operation
6. Readily available furnace filters to collect bulk of overspray
7. Motor brushes out of process airflow (or sealed motor)⁵

Here are my original concept sketches, which were *not* to scale. They show the idea better than my current working drawings:



The concept

The blower is coupled through a tapered duct (‘venturi’) to a rectangular plenum behind the furnace filter. The platform forms the floor of the booth when opened, and the cabinet “door” when folded up.

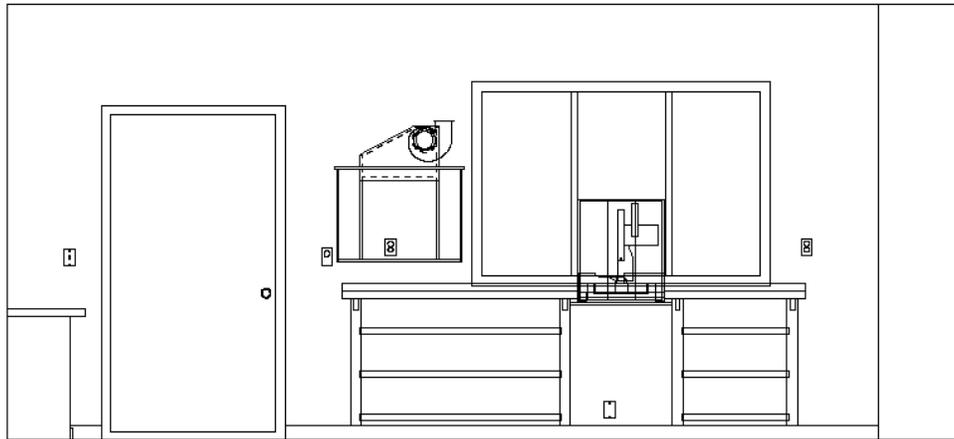
The support arms (spring loaded?) fold out as shown to support a transparent or translucent “roof” and “side walls” of Mylar. A single sheet of Mylar is attached to the sides of the platform and merely drapes up and over the support arms. This should let in lots of light, fold up easily, and be readily replaced when too painted up to use.

Overall size: “Large enough” is an elusive concept. I was quite certain that any size I chose would prove “too small” sooner or later. Pessimism aside, there are space constraints in my crowded shop. The platform, when folded down, can’t project more

⁵ Mostly I will use water-based paints in my airbrush, but for some jobs, Krylon rattle cans—which contain a flammable solvent—are the better choice.

that 26-28 inches from the wall if I'm to have room to stand between it and table saw outfeed. The window has to stay right where it is, and moving that thermostat really isn't an option either.⁶ The distance between them limits maximum width. Height is less rigidly constrained, but a couple of feet "seemed right." Since I'll be standing, I set the platform height at 45 inches.

In the end, I settled for 24" high x 32" wide x 28" deep when opened. Here's how it fits on the wall:



West wall

This reflects current design. Note that the upper fan plenum ('venturi') is now asymmetric, with blower decentered to right, for a reason. Take a look at stud spacing in the west wall (photo taken in 2005 during shop remodel). If I decide to take the vent out through the west wall above the blower,⁷ that space next to the window is the best place to do it:



⁶ I've seen what's inside that wallboard. I hope no one else ever does...

⁷ Not settled yet. I may go up, instead.

Blower size. For high-volume commercial spray finishing booths, OSHA specifies a minimum airflow speed of 75-100 fpm over the entire working face (front opening). Multiply by the area of the working face to get the corresponding cfm requirement. In my case, I need at least

$$75 \text{ fpm} \cdot 2 \text{ ft} \cdot 2.5 \text{ ft} = 375 \text{ cfm} .$$

In practice,⁸ I don't really need that much airflow because (a) I'm spraying much smaller volumes than OSHA envisions and (b) I will be spraying directly in front of the filter, not toward the corners of the booth, which will be stagnant in any event.

I stumbled onto a “new-condition” 350 CFM blower on eBay for about half the price of a new one.⁹ I pounced on that. The blower, a Dayton 4C444, looks like this:



It does look brand new, save for a non-critical dent in the log spiral housing. I wired on a pigtail and plugged it in. The fan ran as smoothly and as quietly as I had hoped, and blew everything off the top of my workbench before I got it unplugged again. Qualitatively, it moves a *lot* of air.

(Actually, this blower might even suck the paint off a model if not properly moderated. BroFred tells me just to throttle the discharge leg to reduce airflow as needed.)

Exhaust duct size. Most “hobby” spray booths, commercial and homemade, use ordinary dryer vent hose for exhaust piping, but this really isn't a good impedance match to this blower. The discharge port measures 4.19” x 3.81” inches (16.0 in²). Five-inch stovepipe (19.6 in²) is a better match than 4” dryer vent (12.7 in²). I'll use ordinary single-wall stovepipe, then.

The fan curve promises better-than-adequate airflow even at high static pressures:

CFM @ 0.000-In. SP 350
CFM @ 0.100-In. SP 340
CFM @ 0.200-In. SP 328

⁸ Let's call this “Compromise No. 1”

⁹ With exorbitant shipping, the total came to \$74.

CFM @ 0.300-In. SP 312
CFM @ 0.400-In. SP 296
CFM @ 0.500-In. SP 274
CFM @ 0.600-In. SP 240
CFM @ 0.700-In. SP 202
CFM @ 0.800-In. SP 158

Since I don't yet know exhaust pipe routing, I can't calculate static pressure, but I'll stick my neck out and hazard that I'll get nearly 300 cfm throughput. We'll see.

What next? I know enough now to begin construction of the plenum and main filter cabinet, so I'll probably start fabricating these soon. Things I haven't yet considered in any detail include

1. Electrical hookup.
2. Manual exhaust throttle.
3. Exhaust vent routing, sealing, and insulating.
4. Compressed air routing, controls.

That's about it for this installment. I'll report back after I've actually built something. In the meantime, please offer any comments or criticisms you feel appropriate.

Regards,

Steve