

CYCLONE COMMENTARY

**by
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(from a message posted on the FOG on January 30, 2005

As many of you know I have invested a little time researching dust collection and cyclones. I am most appreciative of the help from Oneida-Air and many commercial dust collection firms for helping with my education. That education was necessary because after a lifetime of woodworking I had become very sensitive to wood dust. My mad 1994 Christmas rush left me in the hospital with near terminal double pneumonia. Like many in this group, my career and life left me able to buy pretty much any woodworking toy I wanted and I had a full shop of some of the finest European and American equipment available. Unwilling to give up my life-long hobby and sometimes profession, I bought all the "best" hobbyist dust collection equipment recommended primarily by Rick Peters in his DC book. Four years later my 1999 Christmas rush put me back in the hospital again with near fatal double pneumonia. I spent six months in bed on oxygen, mostly working with the Internet to figure out what went wrong and why, then designing my own cyclone dust collection solution.

I learned that much of the common knowledge I was raised with from my professional woodworking father was dead wrong. Air at the volumes and speeds we use in dust collection is more like water in that it will barely compress at all. Any restriction, length of small pipe, small machine port, etc. will kill airflow. I had to revise my mental model of dust collection from my experience with vacuum cleaners that run at roughly eighteen times higher pressures, to one of a flowing stream. We live in that stream of air and what our dust collectors do is tap that flow getting pretty much only the amount of water (air) that can be carried by the size pipe we are using. The idea of air squeezing around small obstructions and speeding up in smaller pipes is a fiction. This means that all our hobbyist systems designed with all different sized pipes were dead wrong because with just one gate open, we lacked the air to keep from getting piles and plugging in our larger mains. The other major paradigm shift required was for me to start thinking about dust collection in terms of sucking. Try to move a balloon with a straw by blowing and it is easy, but trying to move one by sucking is tough. Air being sucked pulls roughly equally in all

directions. This expanding sphere has the airspeed fall off at pi times the cube of the distance. An optimal system designed to move 4000 FPM keeps both vertical and horizontal runs from plugging, but that 4000 FPM turns into far less than 50 FPM just a few inches from our tools. The 50 FPM is the absolute minimum to ensure that normal room air currents do not disperse our air all over. Because FPM equals CFM/duct area we can compute backward and it turns out that nothing less than 800 CFM is ample to provide 50 FPM around our dusty operations whether hand sanding or using a power tool ample to keep the fine dust from spreading all over. We need all 6" ducting to carry that 800 CFM unless we step up to a huge oversized blower and impeller. That means I had to change out my expensive commercial mostly 4" ducting plus make new machine hoods sand dust collection ports.

I then tested the dust collectors made by Jet, PowerMatic, Grizzly, PSI, Reliant, Laguna Tools, ShopSmith, Cincinnati Fans, New York Blower, CFI, and others. ShopSmith and Jet made the only hobbyist dust collectors that actually performed both in airflow and filtering as advertised. All other hobbyist dust collectors came with inaccurate ratings on maximum airflow, filtering, or both. I could not even force many to achieve their advertised maximums leaving me certain these numbers were created in the advertising back rooms instead of any engineering shop. Our real workshops add between 4" to 10" of real resistance. Nothing less than a 1.5 hp motor turning an 11" diameter impeller will move the needed 800 CFM. For that to work you need a clean filter and no more than 10' of smooth walled flex hose all 6" in diameter. To that we need to add more impeller and motor to overcome the resistance of our shops added by ducting and a separator. Almost all need at least a 2 hp motor turning a 12" impeller do capture the fine dust by getting a real 800 CFM to our machines with no separator. Adding a separator pushes that to a 3 hp motor turning a 14" diameter impeller to move than much air.

The 3 hp dust collectors were expensive and still would not work because of impeller and filtering problems. The PSI 3 hp used too small an impeller as did the Grizzly and most other Chinese made imports. Again Jet was the only hobbyist vendor who provided a unit that actually worked at the claimed maximum airflow ratings. Even with it, by the time I added my ducting actual performance was about half that rated. In fact, figure about half the maximum performance as a reasonable estimate of actual working performance for any dust collection blower. I also tested at UCD the filter bags from Grizzly, PSI, Highland Hardware, Jet, PowerMatic, Delta, Woodtec, and Rockler.

Two of my professor friends conducted similar independent tests at their universities. We all got identical results. The reputable makers accurately advertised 30-micron filter bags and the rest claimed filtering levels that could not be reached until their filters were so plugged they would hardly pass air. Any could and did claim any level of filtering desired by simply clogging their filters until they got the desired performance. Worse, all of these bags including my custom tall bags, had less than on tenth the surface area recommended by ASHRAE, the independent society of heating and air conditioning engineers. As a result, all of these bag type filters plugged quickly killing the airflow needed for good dust collection. Going with their recommended roughly one foot of filter area for each 1 CFM of airflow was going to leave me with no shop unless I moved to cartridge filters. Moreover, I needed to get into the expensive cartridges that provided full airflow while filtering down to 0.5-micron particle sizes. I decided to live with more cleaning and shorter filter life and bought a pair of expensive 0.2- micron Donaldson/Torit filters and mounted them on my dust collector, wrote up the results, and not long after saw Jet sort of copied me with their canister unit.

Although a clever solution, this worked terribly because my filters quickly clogged. Adding a separation screen saved the filters but left me cleaning the screen every few minutes of use. The only way to clean my shop air without blowing my air outside was to use a cyclone separator to get rid of most of the particles before they got to those filters. I added a Grizzly trashcan separator sold by Woodstock, their sister division. It worked well at pulling off the sawdust, but killed the airflow at my machines by adding 4.5" of resistance. Worse, it sent all the fine dust right into my filters anyway and it went right past my screen. I surrendered bought an early PSI cyclone then made or at least engineered by Oneida-Air, and found it worked worse than my DC with the trashcan separator. PSI used the same 10.5" diameter impeller on every unit from their 1.5 to their 3 hp blower getting not on lick better performance out of their expensive 3 hp dust collectors and cyclones than they did out of their 1.5 hp units. After a long ugly fight with them I gave up losing my shirt financially. I then built a Wood Magazine copy of the same unit and it worked even worse gravely under powered and barely giving me 350 CFM at my machines. That convinced me to buy an Oneida-Air cyclone.

Brian Lamb and others advised me they were not really happy with their Oneida-Air cyclones either. A friend of mine had one and I spent a lot of time with it working out its problems and recommended he

replace that internal filter with a pair of external filters similar to mine. It still had clogging problems when making certain types of chips and dumped virtually all the fine dust into the filters making for a constant cleaning problem. It turns out that PSI and Wood Magazine cyclones that copied that same design had the same problems.

A little research showed me that all of these copied the original 7.5 hp Delta cyclone designed for a small one or two person shop. That unit was placed outside and used a bag separator with the fine dust just blowing away. The Oneida-Air version designed by Dr. Witter used a larger cyclone so it could be powered with a smaller motor, but maintained the same dimensions. Those dimensions came from early agricultural work where cyclones were designed with horrid internal turbulence to break loose grain from chaff and separate cotton fiber from dirt and sand. They simply blew the lighter particles out the top, so this design is worthless for fine dust separation. An elongated inlet misnamed a neutral vane keeps the internal turbulence down some creating a cyclone with only about 4" of resistance, but still something that is terribly inefficient and needs at least a 3 hp motor turning not less than a 14" impeller to assure getting our needed 800 CFM at our machines. I did a lot of research and ended up going with a far more efficient design then added to that design my own improvements to make it even better in terms of reduced resistance and increased separation. I added a long inlet to stabilize the incoming air, added an angle to that inlet with spiral air ramp to keep the air from crashing into itself and minimize resistance, and I did the engineering calculations to redesign the cone dimensions for optimal fine dust separation. I also came up with the efficient airfoil blower suitable for small shops and an appropriately sized and powered material handling impeller for medium to large shops. The results work well giving less than 2.5" resistance with roughly a ten fold advantage in terms of fine dust separation over the other cyclone designs. I have one firm that CNC machines MDF all day long generating many 55-gallon barrels of dust every week. MDF will clog other cyclone filters in minutes, but they only had a few tablespoons full of fine dust after two months of operation.

Currently I only recommend dust collection from Felder, the 3 hp Oneida-Air cyclone, the WoodSucker II, and my designs either in the form of kits or plastic Clear Vue units from Ed Morgano. Nothing else in the hobbyist world has the ability to move enough air and provide ample filtering without rapid filter clogging or poor fine dust separation. Fortunately, the increased industry awareness in this area, plus a lot of work will hopefully soon be generating big changes.

Oneida-Air has been one of my strongest supporters and I freely helped them as I went making recommendations for efficiency, impeller, and filter improvements that are now on all their 2 hp and larger units. I also helped WMH (PowerMatic and Jet) with new designs that hopefully will be coming out soon in their new commercial product lines. PSI and I got into a fairly heated fight over my comments about their pretty, but poor quality products. I ended up contracting with them last fall and revised their blower and cyclone designs. Their new units with whatever changes they choose to make should be available soon. I similarly got into more than a little heated battle with Grizzly over their flagrant testing of blowers with impellers bigger than they actually shipped. We fought ourselves into a mutual cold war with Grizzly announcing a whole new line of hobbyist cyclones late last year. My evaluation based upon looking at the pictures of the prototypes proved right on, these units were garbage and worked poorly for indoor use just like the early units they copied. Bill Crofoot with Grizzly swallowed his pride and came to me for advice. We worked through why those new units had problems with his taking my recommended repairs from my web pages. I understand what they plan on shipping in the next few months will be totally different units far closer to my design, it not my design exactly. I'm not very bright because I got nothing from any of these firms other than a few test products that were of no use.

Regardless, we are going to see lots of excellent offerings later this year. Meanwhile, please protect your respiratory health so you don't end up like me sucking on an oxygen hose and only able to stand or walk a couple of hours a day.

bill