Northwest Woodworkers Association

THE SAWDUST NEWS

Northwest Woodworkers Association

February 2016 http://www.nwwoodworkers.org

An association for woodworkers of all skill levels to share their common interest

The Next Meeting

Date: **Thursday, March 31, 2016 at 6:30 PM**
Location: **Rockler Woodworking - Northgate**
832 NE Northgate Way
Seattle, WA 98125
Program Highlight: **Mega Show 'N' Tell**
Bring your latest projects to share. Be sure to bring along a thumb drive with your photos of your build, tooling, jigs, etc.

February 2016 Meeting Highlights

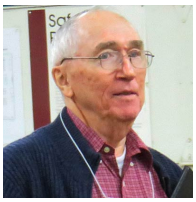
Newsletter Photos by Scott Wilson
Meeting Notes by Chris Yee

The **February 2016** meeting of the **Northwest Woodworkers Association** was held on **Thursday, February 25, 2016** at **Woodcraft** with **15** members present. We were glad that so many of our members were able to attend and share in such an interesting meeting.

Thanks to members **Eric Blom, Jim Glynn,** and **Chuck Hart** who were able to attend and share their experiences and thoughtful questions about dust collection systems. Thanks for your good input, guys!

We want to express our appreciation to the **Ron and Michelle Hall** and the **Woodcraft** staff for providing a wonderful venue for this meeting. We really appreciate your long standing support of the **Association**.

Current Projects & Show 'n' Tell



Charlie Culler gave us an update on his fishing net frame project he showed at the last meeting. He noted that he was able to resolve the issues he was having related to forming a groove around the inside and outside of the frame to provide a place to secure the knots holding the net to the frame. He said he used multiple passes with a round nose router bit to form the grooves. **Charlie** also showed us the custom laser engraved signature he was able have applied to the frame of the net, courtesy of the folks at **Rockler - Northgate**, who performed the operation for him.

Dan Cordwell brought along a clock/weather instrument center he had upgraded with a new wooden case to put in his shop. He also showed us a shaped hardwood auxiliary handle he had made for one of his small hand planes to make the grip more comfortable. Great and useful projects, **Dan**!

Tom Nailor showed a variety of unique solutions for some clamping situations he recently encountered, from simple glue-up clamping, to a "use all the clamps you have in your shop" type clamping, to a very innovative approach for clamping wooden panels to the outside of an air conditioning duct in his home – a situation in which his clamps were not long enough to span the required distance. He solved the problem by altering metal paint can openers to hook over the top of the duct, with one end of a clamp secured to the other, triangular, end of the opener. He also used some wedges to apply force to the bottom panel of the glue up. That's literally "thinking outside the box", huh **Tom**!! Great solution!

Program Highlight
Two Approaches to Dust Collection

As a sort of follow-up to our last month's meeting in which we "visited" member's shops via photo tours, we were treated to a very interesting program about dust collection by two of our **Steering Committee** members, **Bill Bond** and **Paul Stoops**. Each of them discussed their current shop dust collection systems, including equipment selection, ducting design, and system performance.

Bill described the selection process, installation and duct design, and performance of his commercially built high performance cyclone dust collection system. In contrast, **Paul** talked about the custom design criteria, fabrication, installation and performance testing of a DIY dust collection system for his small "woodworking corridor". These two presentations illustrated the wide diversity of approaches to accomplish the same goal!

Bill Bond noted that one of the issues that persuaded him to invest in a high performance dust collection system for his shop was health problems that he attributed to excessive exposure to woodworking dust! Wow! What better reason can one have?! It's great that you took the needed steps to resolve the problem, **Bill**.

He described his search for a suitable system for his double garage sized shop, with the three most likely candidates being a **Laguna 2 HP** cyclone system, a **Powermatic 3 HP** 4-bag single stage unit, and a **Penn State 2.5 HP** cyclone system. After careful consideration, **Bill** decided the **Penn State 2.5 HP Tempest 1425S** cyclone system was the best fit for his shop.

This cyclone system is a wall mounted unit which includes two high performance pleated filters, rated at **99.9% efficiency at 0.3 micron**. This unit has a fan with a **14" diameter** aluminum impeller and a small installation footprint. The equipment specifications and fan performance curve for this unit indicate that it is one of the better ones available to the home shop woodworkers today, and is available at a reasonable price point for a quality system. It should perform beautifully in **Bill's** shop and do a great job of capturing the super fine dust that is so harmful. Good choice, **Bill**!

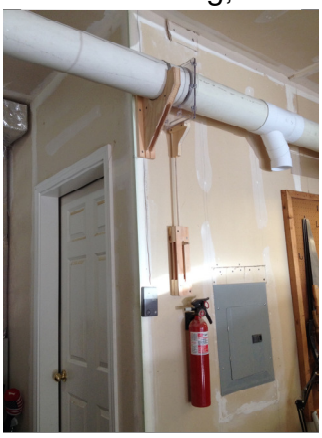
He showed some of his preliminary sketches of the proposed installation and duct layout, followed by photos of his actual installation. To minimize the noise level in his shop, **Bill** built a sound insulated enclosure for the cyclone and fan, with the filter stack located alongside.

However, after completing the installation and taking some sound level measurements, he opted to move the cyclone filter stack to the other end of his shop and insulate its connecting ductwork with double wall insulated HVAC ducting. Noise level measurement made before and after this change demonstrated an **8 dBA** reduction in noise level – a very substantial change! Unfortunately, a large diameter, high performance fan, moving a lot of air, generates a whole lot of noise!

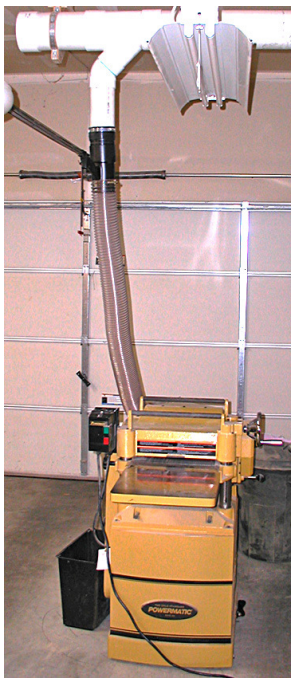
Shop Vacuum System
Noise Level Comparison

	VACUUM SYSTEM ON	VACUUM SYSTEM OFF	Dba Ave.	Noise Reading Description
		X	18	Background Noise
		X	56	TV on
Exhaust Duct Not Insulated	X		91	System Gates Closed
	X		86	System Gates Open
	X		62	Outside Shop
Exhaust Duct Insulated	X		83	System Gates Closed
	X		80	System Gates Open
	X		60	Outside Shop
	X		87	Table Saw ON
		X	79	Table Saw ON
	X		86	Planer ON
		X	77	Planer ON
	X		82	Jointer ON
		X	79	Jointer ON
	X		83	Shaper ON
		X	77	Shaper ON

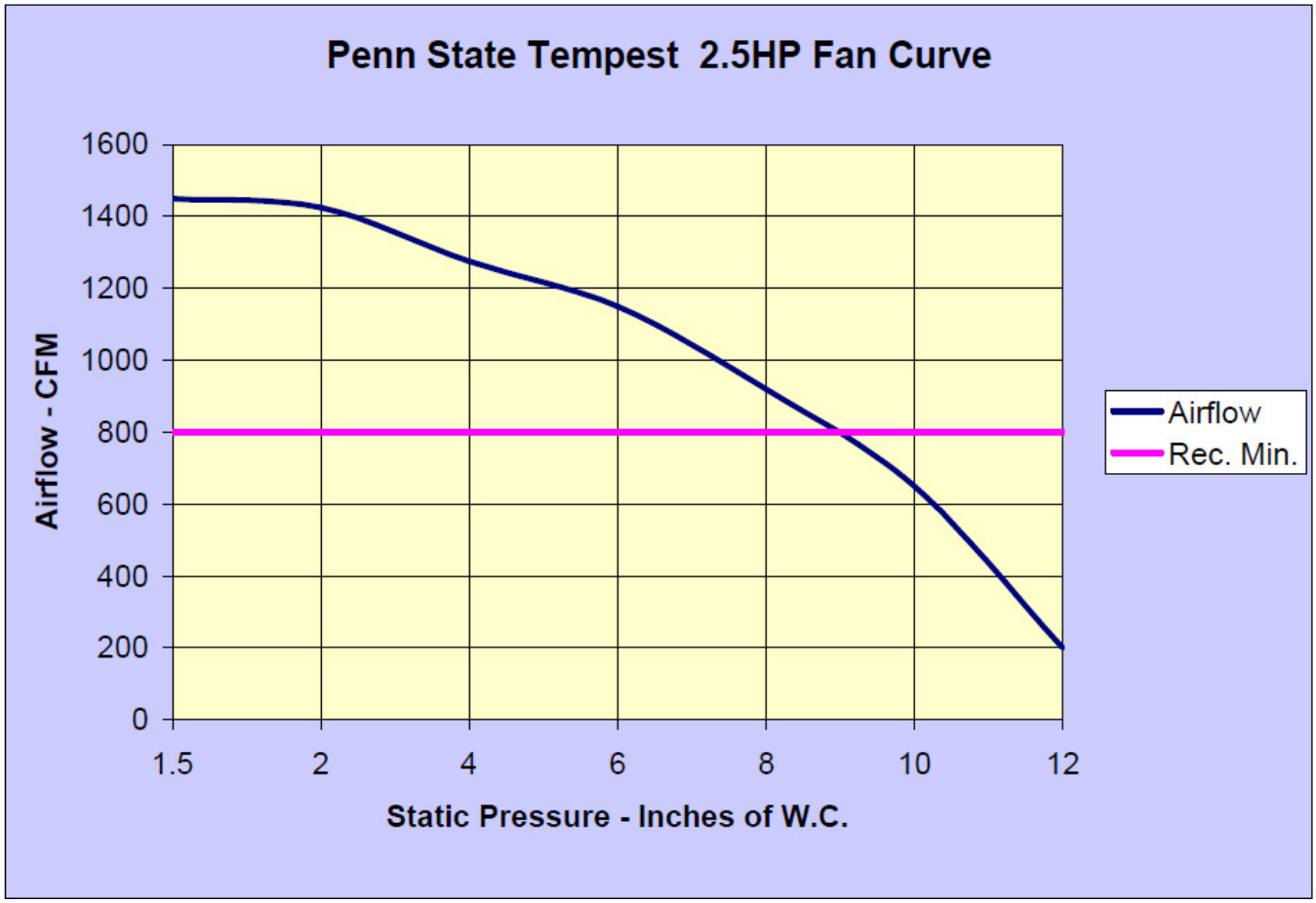
Bill showed us several photos of his **6" diameter thin wall PVC** ducting system, including some well thought out duct routing and machine porting. Of special interest was his unique use of blast gates to control airflow to specific machines. Because his ducting system was routed near the ceiling, he designed some really unique, wall-mounted, sliding actuators to open and close the gates from floor level. A really great, innovative solution, **Bill**! Sure beats having to stand on a ladder (or stilts!) to open and close the blast gates! ☺



Another wise choice **Bill** made in routing his overhead ducting was the incorporation of cleanouts at the end of straight branch ducts – nice feature to have if you ever need it! He also made use of quick disconnect fittings on the flex hose for his duct-to-machine connections making it easy to reconfigure his machine locations as required.



To illustrate the fine performance of this **Penn State 2.5 HP Tempest** cyclone system, **Bill** showed us the **through-the-cyclone fan curve** published by **Penn State Industries** for this equipment. Note that this data does not account for static pressure losses from the ducting system, though it does account for the losses produced by the cyclone separator.



Notes:

1. Static Pressure may be defined as the **resistance to airflow**, and is measured in **Inches of Water Column**. There are numerous factors that contribute to the total **Static Pressure** of a duct, including the diameter and length of the duct, the smoothness of the duct material, the number and configuration of the duct fittings, the end configuration of the duct, and many others. In order to provide the desired airflow, a dust collection system should be configured to **minimize** the **Static Pressure** of the duct system, and the air handling equipment must have sufficient capability to **overcome** the total **Static Pressure** loss of the ducting system. **Airflow decreases with increased Static Pressure**. Small ducts and machine ports and tight radius fittings substantially **increase Static Pressure**, producing **decreased** airflow. **Static Pressure calculators**, such as those noted in the references later in this article, are very useful system design tools.

2. The recommended **800 CFM** minimum airflow is the accepted industry standard for a **6" diameter** duct system in order to maintain the **4000 FPM** air velocity required to ensure that dust and debris remain suspended and do not accumulate in the ducting.

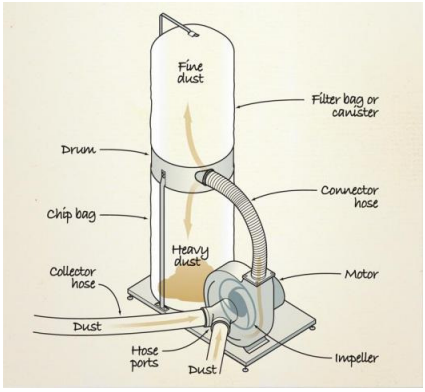
As can be seen on the graph this unit appears to have substantial headroom above the recommended minimum airflow to offset static pressure losses from ducting, fittings, ports, etc.

This appears to be a really great system for your shop, **Bill**, and should serve you well for years to come! You obviously put in a great effort in developing and installing the system. This is a great illustration of a well executed plan! Good job. **Bill**! Great investment in your good health!!

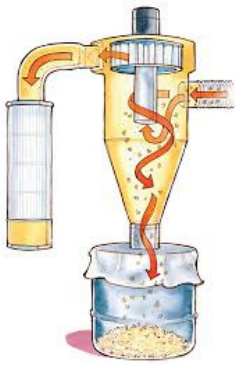
Embarking on the second leg of our dust collection journey, **Paul Stoops** noted in last month's meeting that when he moved into a gated senior community, he left behind his powerful **5 HP Clearvue** cyclone, and now does his woodworking in his 180 square foot "woodworking corridor". That said, he noted that he is happy even having a shop to work in, despite its limitations. However, one thing good about having a much smaller shop is that a more modest dust collection system can provide the needed performance. **Paul** noted that since the late 1990's he has had several different dust collection systems, from his first wimpy **1 HP single stage**, double bag system that blew fine dust all over the shop through the porous canvas bags, to a **5 HP Clearvue** high performance two stage cyclone system with dual high efficiency filters.

However, assessing his needs for his new, smaller shop, he decided he would experiment and build a custom system incorporating a relatively recent hybrid design innovation called a **Thein Baffle,** named for its inventor, **J. Phil Thein** (pronounced **Theen**).

To help set the stage for the discussion of his custom system, **Paul** showed some illustrations of the two most common dust collection systems in use in today's hobbyist woodworking shops (not including shop vac systems).



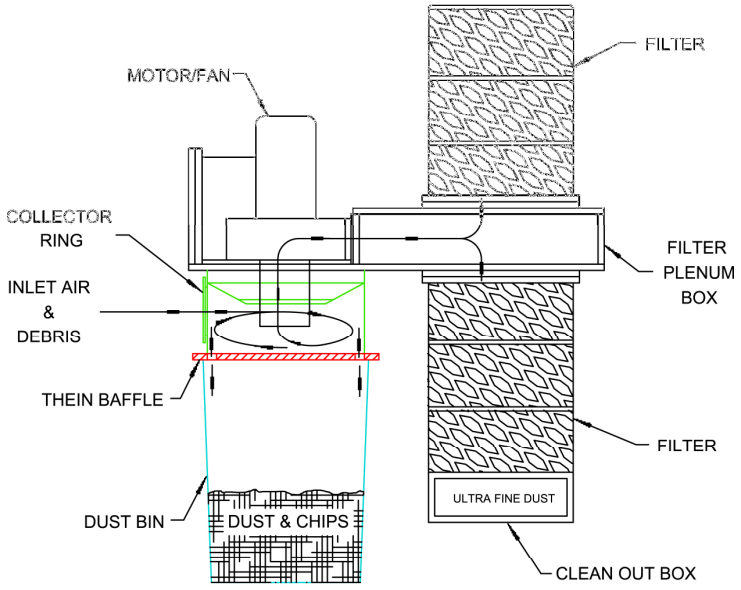
Until fairly recently, **single stage** bag type dust collectors were probably the most common hobbyist dust collectors available. Most of the early models were characterized by porous canvas bags above and below a collector ring. They are classified as single stage because the dust and debris enter through the fan and are exhausted into the collector ring, relying on the heavy debris and larger dust particles falling by gravity into the lower bag and the finer dust becoming entrapped in the upper bag. However, most of the early models had **30 micron** bags, which allowed very fine dust particles to escape into the air – **those particles being the ones most damaging to the lungs!** More modern versions of the single stage design incorporate impervious lower plastic bags and high filtration pleated paper filter canisters in place of the porous upper bags. Unfortunately, the single stage design is very inefficient for separating the very fine dust particles, requiring frequent cleaning of even the best canister filters. However, one benefit of these single stage systems is that they are typically mounted on caster-equipped bases, allowing them to be moved around the shop from machine to machine, minimizing duct/flex hose lengths.



The other commonly available dust collector is a **two stage** cyclone system. These are usually more expensive than the single stage bag type designs, but provide dramatically improved performance. They are wall or floor mounted systems designed to be used with fixed duct installations. Because the motor is typically top mounted, one drawback of the cyclone systems is that they typically require excessive headroom, though many of

them are now designed to fit within a typical 8 ft. shop ceiling. The two stage design involves delivering the dust/debris laden air into the upper barrel of the cyclone tangentially along the inner wall of the cyclone barrel. Contact with the wall of the cyclone slows the air velocity, allowing gravity to pull the debris and heavier dust particles downward into the conical section of the cyclone, further slowing the velocity and depositing the dust/debris in a collection bin at the bottom of the cyclone. Some of the cyclone dust collectors, such as the **Clearvue** and others, have a downward inclined air ramp to further direct the air toward the bottom of the cyclone. The return air and very fine dust particles pass upward through the fan and are exhausted into a filter stack outside the cyclone body. The two stage design tends to efficiently remove all but the very finest dust particles, which are collected in the filter stack, typically having a cleanout receptacle at the bottom for periodic removal of the ultra fine dust. Unlike the single stage design, the heavier dust and debris, including small offcuts, do ***not*** pass through the fan.

In recent years, a third dust collector configuration has emerged as a popular alternative, particularly with DIY woodworkers on limited budgets, who enjoy the challenge of making their own shop equipment. These dust collectors incorporate a recent innovation, called a **Thein Baffle**, making a kind of a "poor man's cyclone" hybrid design. Most of the **Thein Baffle** systems employ the motor/fan assemblies from single stage dust collectors, such as the 2 HP single stage dust collectors marketed by **Harbor Freight Tools,** and others.



THEIN BAFFLE DESIGN CONCEPT

Note from the illustration that this design has similarities to both single and two stage designs, but is really a two stage design, since the incoming dust/debris does ***not*** pass through the fan, but instead enters the collector ring and passes around a curved slot in the **Thein Baffle**, where the heavier dust and debris fall through the slot into the dust bin. The **Thein Baffle** helps keep the debris in the dust bin from recirculating upward into the fan and filters. For smaller shops, this design typically operates as well as, or better than, a single stage design, but not as efficiently as a two stage cyclone and ***does not separate the fine dust particles as well, requiring more frequent cleaning of the filters.*** However, the design is very simple, and can be easily fabricated at a modest cost by the typical DIY hobbyist woodworker. Though

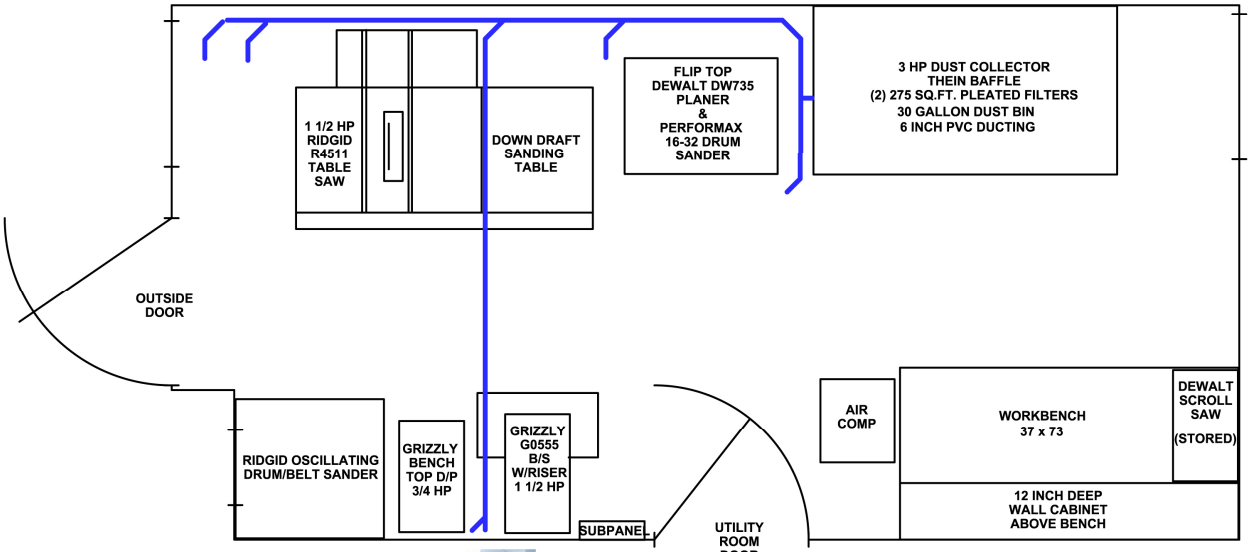
somewhat bulky, this configuration can also be mounted on casters so that it can be moved around the shop. More information on the **Thein Baffle** design may be found in the references cited later in this Newsletter.

Considering the small size of his shop, **Paul** developed the following design criteria for his custom DIY dust collection system:

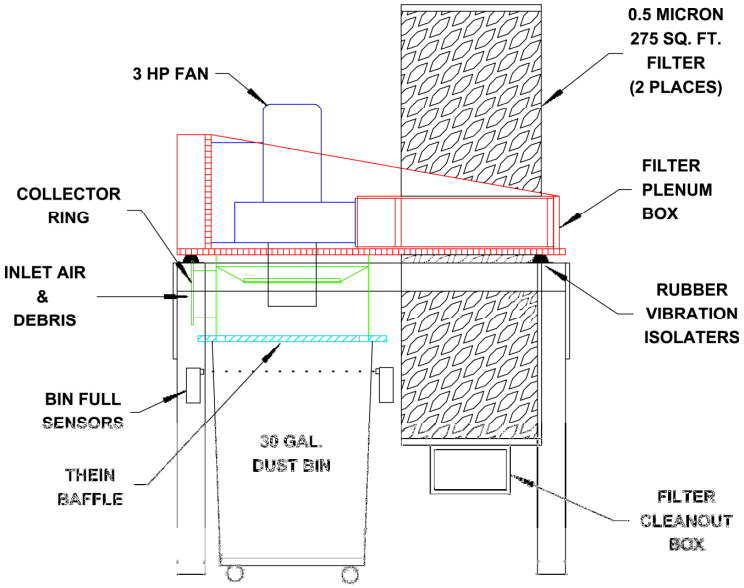
SYSTEM DESIGN CRITERIA

- **THEIN BAFFLE DESIGN CONCEPT**
- **2 - 3 HP FAN**
- **SOUND INSULATED ENCLOSURE**
- **6" PVC DUCTING AND FITTINGS**
- **REMOTE CONTROLLED START AND STOP**
- **MOTOR CURRENT MONITORING CAPABILITY**
- **BIN FULL SENSOR SYSTEM w/ STROBE LIGHT ALARM**
- **HIGH FILTRATION CARTRIDGE FILTERS**
- **SHOP LIGHTING ENABLED SYSTEM**

With these criteria in mind, **Paul** designed a duct layout to suit his "woodworking corridor", using **6" diameter, thin wall PVC, ASTM 6-2729 S&D,** ducting and fittings. The ducting essentially runs down one wall of the shop and above the ceiling across to the other side of the shop to a vertical drop.



Recycling a **12" diameter, 3 HP** fan and collector ring from a 20 year old, Belsaw four bag single stage dust collector, he developed this final design for his DIY dust collection system:



FINAL THEIN BAFFLE SYSTEM CONFIGURATION

In this photo of the finished installation, the plywood filter plenum box, fan motor, collector ring, **Thein Baffle**, dust bin, and dual filter stack can be clearly seen. These items are all mounted on a simple 2 x 4 wooden base. Extra space under the unit is used for storage.

To minimize vibration transmission from the filter plenum box to the floor, the box was mounted on four rubber vibration isolators.

But the star of the show is the plywood **Thein Baffle**. This view shows the ***bottom side*** of the **Baffle**, which has a groove that engages the gasketed top rim of the garbage can dust bin. The curved slot, flush with the inner wall of the dust bin, is **1 1/8"** wide and **240º** of the circumference. The inlet air enters the collector ring across the solid portion of the **Baffle**. The **Baffle** is secured to the bottom of the filter plenum box with four lengths of **All Thread** engaging tee nuts, capturing the collector ring between the **Baffle** and the box.

To prevent overfilling the dust bin, creating a nasty (DAMHIKT), ***major*** filter cleaning job, the dust bin was outfitted with **Genie** garage door opener sensors, which send and receive through plastic windows on opposite sides of the dust bin. When the dust/debris rises to a level which obstructs the sensor beam, the bin full sensor circuit activates a strobe light on the shop side of the wall – which really is an attention getter!

To minimize noise transmission into the shop, the entire dust collection system was enclosed in a sound insulated enclosure. Exposed for maximum sound absorption, **Rockwool** batt insulation was used to fill the stud and rafter spaces. The double doors were similarly sound insulated. The electrical contactor for the fan motor and other electronics are seen mounted in the side wall (cover removed). Noise measurements of the completed system showed a noise level of **78 dBA**.

Remote control of the dust collector is accomplished with a small **X10** pushbutton remote, receiver, and other control components. For motor current monitoring purposes, a wire loop from the contactor circuit passes through the enclosure wall and a plastic insulating fitting holding a clamp-on ammeter. The bin full strobe light is also visible in the photo. The light switch enables/disables the dust collector to prevent inadvertant switching of the dust collector from line current spikes.

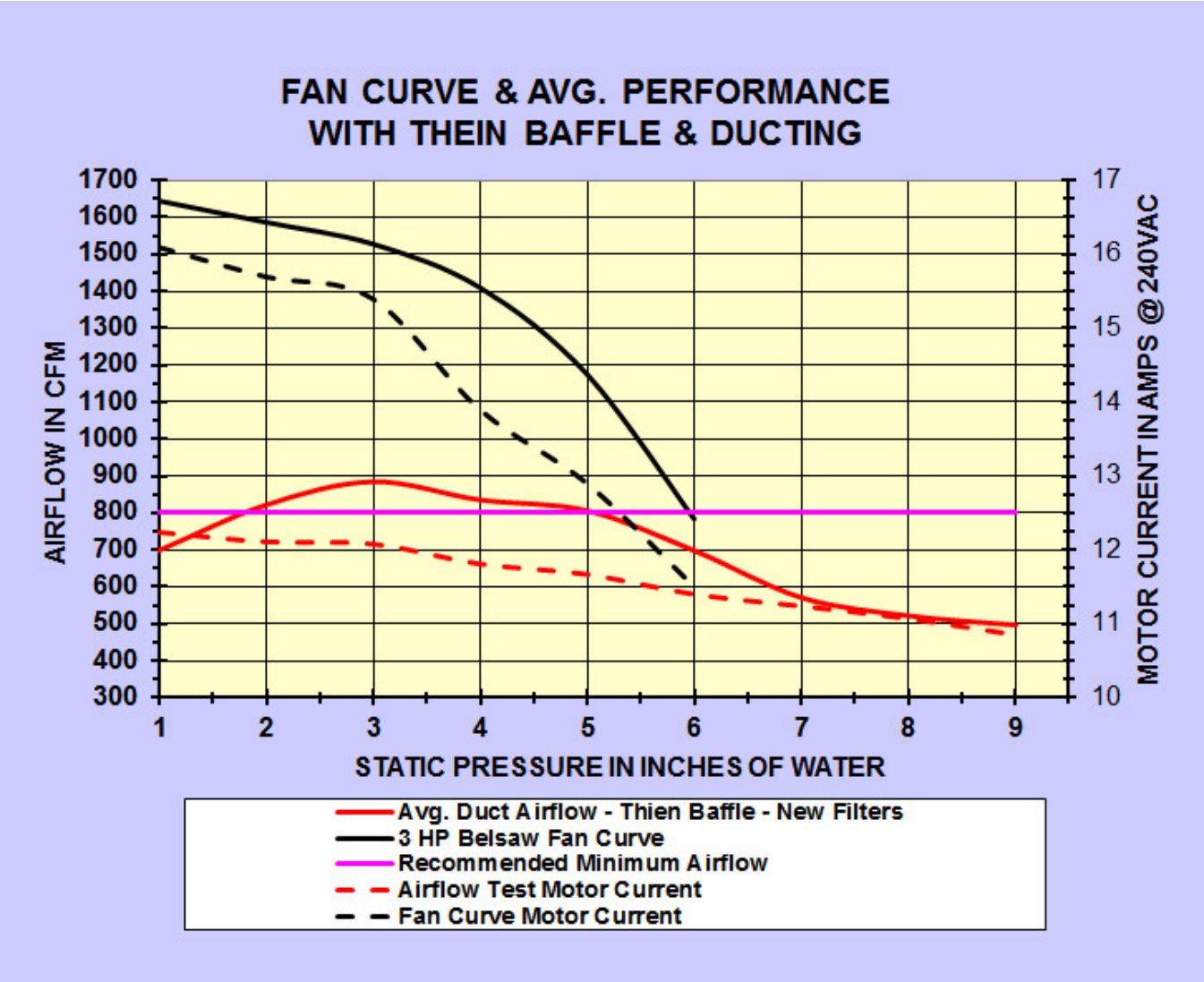
Although for a retired R&D engineer, this was a fun project to design and build, the $64 question is, ***"How well does it perform?"***

To answer that question, **Paul** showed graphs of the **Airflow vs. Static Pressure** data he collected during system testing. The **Fan Curve** reflects the maximum air moving capacity of the fan at various **Static Pressure** levels; the **Performance Curve** indicates the average airflow of the **actual** ducts in the completed system with the **Thein Baffle** and filters installed. It should be noted that this data refers to performance with **6"** diameter ducting.

Analysis of the graphical data clearly demonstrates the dramatic performance reduction between the **Fan Curve**, produced with a straight **12 D** (duct diam.) long industry standard test duct and the actual **Average System Duct Airflow**, which includes longer ducts with several fittings. It would appear that air turbulence in the ducting, probably due to the change in airflow direction and the additional friction produced by the fittings, along with the added effects of the **Thein Baffle** and high performance filters, account for much of this performance hit. This phenomenon was not totally unexpected, because ducting runs and any sort of separator, including cyclones, do substantially reduce system performance. Frequently, high performance cyclone systems, like **Bill's**, employ larger diameter fans (i.e **14" vs 12"**), with engineered configurations, capable of moving substantially more air, to offset the system losses.

That said, a system with **engineered components** such as fans, cyclones, etc. can be designed to minimize the system losses and maximize overall performance. **Bill's Penn State Tempest** cyclone system, having an engineered **14"** diameter fan and cyclone design, is a great example. Unfortunately, for limited budget DIY system builders, the choice of components and design features are usually limited to whatever equipment is available. Consequently, lower operating performance is not a surprise. However, as long as a DIY system performance meets the required level, satisfactory operation can be achieved.

However, it is obvious that a typical DIY system is probably much better suited to a small shop with short ducting runs.



[**Ed. Note:**] *There is a great deal of controversy related to the minimum airflow requirement. The **800 CFM** cited here is probably the top of the recommended range, which would be suitable for such tools as planers, and table saws with over- and under-table dust collection. Some knowledgeable folks specify values as low as **500 CFM,** which would be suitable for such tools as bandsaws, etc. Due to the complexities of dust collection, my personal opinion is that it is better to be conservative and err on the high side, particularly where health issues are concerned.*

It is interesting to note that **Paul's** DIY **Thein Baffle** system does meet the **800 CFM** minimum recommended airflow for **6"** diameter ducts over a range of **1.8 – 5 inches W.C.** The **Static Pressure** calculated for the worst case duct in his system was about **3.4 inches W.C.**, which falls nicely into the middle of that range, with some headroom to spare. Using the alternate **500 CFM** minimum requirement, his system meets the requirement over the whole range of **1 - 9 inches W.C.**! Since most woodworkers lack the equipment to make airflow measurements, the numbers are somewhat academic, although in the dust collection world bigger is probably

better! Having a dust collector with more capacity than you think you need also allows for future expansion.

As with most things, there are no free lunches! Higher capacity dust collection systems are inherently more expensive, sometimes require higher capacity electrical circuits, and operate at higher noise levels. A complete, ducted dust collection system represents a substantial investment, so sometimes trade-offs have to be made. However, many of us have started small and over time have been able to upgrade our systems to higher performance levels.

It should be noted that although our presentations discussed the perks and quirks of fixed dust collection systems with **6"** ducting, many woodworkers, including some of our own members successfully use portable single stage dust collectors outfitted with **4"** diameter flex hose in their shops by moving the dust collector from machine to machine. However, because **4"** diameter ducting and flex hose produces over **1.5** times as much **Static Pressure loss** compared to **6"** ducting, the smaller ducting may produce marginal performance for fixed duct installations with long runs.

That said, it is advisable to run the maximum size ducting in your system as close to the machine as possible before transitioning down to a smaller size. Where possible, enlarge your machine ports to at least **4"** diameter. Although small **2"** ports found on many machines permit limited dust collection with a shop vac, due to its ***high*** Static Pressure capacity, they seriously restrict the airflow from a typical high volume, ***low*** Static Pressure capacity dust collection system, ***regardless of the size of the system fan or ducting***!

As a final note, dust collectors are not a substitute for a quality dust mask or respirator!

Additional information related to dust collection may be found in the following references:

- http://www.oneida-air.com/static.asp?htmltemplate=static/ductwork_tutorial01.html
- http://www.jpthien.com/cy.htm (This site also has an extensive Thein Baffle user forum)
- http://www.woodmagazine.com/woodworking-tips/techniques/dust-collection/figure-dust-collection-needs/?page=3
- http://billpentz.com/woodworking/cyclone/ (Very authoritative comprehensive discussion of all things dust collection, and especially cyclone systems)
- Harrington Industrial Plastics (Local source of thin wall PVC pipe and fittings) https://store.hipco.com/viewCategory?id=HOME-PIPE-FITTINGS-ACID-WASTE-DRAIN-FITTINGS-PVC

Note from the Editor

It was great to see the number of members at the meeting and the level of interest and hear thoughtful questions asked about this somewhat mysterious dust collection stuff! If you have further questions or disagree with the information we have presented, please let us know so we can discuss it with you – and correct any misinformation we may have unknowlingly given. I certainly am not an expert

and do not have all the answers, but I have tried to share my knowledge and experience, along with others of our Association. Sharing what we know makes all of us better woodworkers!

A special thanks to **Chris Yee** for helping us out by taking the notes for this meeting in the absence of our Secretary **Jan Erickson**. Good job, **Chris**!

Sad to say, but the subject of dust collection is one of the most controversial ones to be found on the woodworking forums. For some strange reason, this subject has caused more verbal fist fights than any I have ever seen! Be aware that there are about as many opinions offered as there are folks offering them, and there are a lot of closed minded folks out there. However, I personally have found that there are many technically knowledgeable folks in the area of dust collection on the **Sawmill Creek** woodworking forum (http://www.sawmillcreek.org/index.php), who appear to present factual technical information in a neutral fashion. I suspect that some of these folks work in the air handling industry.

Because dust collection/airflow is a very complex technical issue, it is difficult for the typical hobbyist woodworker to determine what to believe. Altho the situation has improved, part of the problem lies with unrealistic performance data often included in the sales literature from the dust collection equipment companies. For instance, simply specifying that a particular dust collector will produce **XXXXX CFM** of airflow is totally meaningless unless the number specified ***includes*** the **Static Pressure at that airflow**. Some of the more reputable companies, like **Onieda Air**, **Clearvue Cyclones**, **Penn State Industries**, **Grizzly**, and others have recently started publishing the **Fan Curves** for their equipment, which specifies this information. This is a big help to the woodworker who is trying to decide which equipment to purchase for his shop, or is trying to choose between available candidates. However, as has been evident from some of the evaluation articles published in woodworking magazines, the magazine article test results sometimes vary widely from the vendor published data. That said, some of those differences are attributable to differences in the testing methods used.

Though manufacturers are publishing more performance data, be aware that sometimes the marketing folks have a whole different view about performance data than the design/engineering folks, so be willing to apply at least a few grains of salt when shopping!

Happy and Safe Woodworking!

Paul

Woodworking Employment Opportunity

We have been advised of a full time woodworking employment opportunity from a local recruiter who is advertising ***"an opportunity to work with a great company that manufactures all custom office work. This could also be an opportunity for a person that has the passion or drive with little experience."***

If interested, please contact:

Carmen Kier, Recruiter, TERRA Staffing Group, 425-822-2929
www.TerraStaffingGroup.com

Northwest Woodworkers Association Sponsors

We appreciate the generous support provided by our NWWA sponsors, from providing member discounts on purchased items to providing state of the art venues for us to conduct our monthly meetings. Thank you, Sponsors!

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We encourage our members to contact any of the above individuals with questions, comments, or items that may be of interest to the membership.

In addition, please visit our website and forum: http://www.nwwoodworkers.org