

## Health hazards in the shop

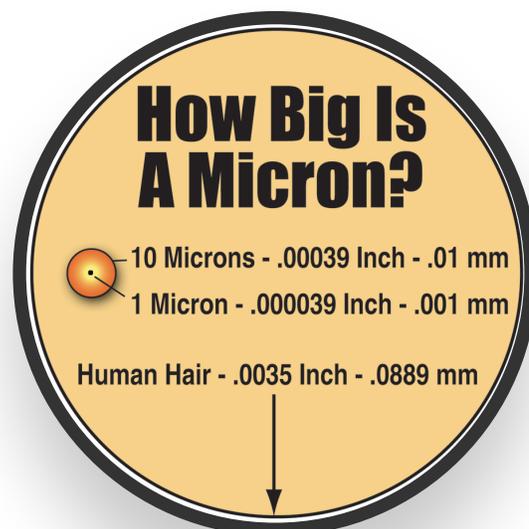
As luthiers we are all aware of the many health hazards and dangers we encounter on a daily basis as we exercise our craft. Sharp objects, hand tools, power tools, and chemicals from finish and repair work are some that come to mind almost immediately. I would venture to say that many of us also play the instruments we make so just the thought of losing a finger and not being able to play anymore is enough to make us take measures to avoid this scenario. However, there is a danger in the shop that is often overlooked and even in cases when we are aware of the danger we do little or nothing to address the problem. I am referring to wood dust. We protect our eyes and ears in the shop but what about our noses?

The health hazards of wood dust and its effect on the human body are well documented. Some wood dusts are toxic or carcinogenic. The United States Department of Labor OSHA website (<http://www.osha.gov/SLTC/wooddust/>) has this to say about wood dust. "In general, exposure to excessive amounts is considered to have an irritant effect on eyes, nose and throat in addition to pulmonary function impairment and is considered a human carcinogen. Western red cedar dust has also been shown to cause asthma."

Now wait just a minute! I use this species on my guitars. Now I am paying attention!

The OSHA site also has a bunch of other information that will put the fear of God into any woodworker when it comes to the effects wood dust has on the human body.

Most of us know that dust in our shops is a major nuisance. But how many realize that excessive exposure to wood dust can cause health problems as well? Frequent exposure to large amounts of wood dust can lead to sinus and lung problems, or worse. The smallest dust particles are the most dangerous as they can enter the body and are difficult to remove. According to industrial hygienists, the smallest dust particles 1 - 10 microns in size are the unhealthiest to breathe. This is known as the (PM 10) range. Any particle in the PM 10 range enters and is easily trapped in the lungs making it very difficult for your body to expunge. To put that size in perspective, consider that a human hair is about 100 microns thick, while airborne dust particles smaller than 20 microns are invisible to the naked eye. With the slightest breeze, dust particles in the PM10 range are stirred up into the air where they are suspended for extended periods of time presenting more of a danger to you.



Fortunately, the human body has a built in cleaning system in the lungs that under most conditions is able to protect us from the effects that wood dust causes. The problem begins when the respiratory system must deal with large amounts of dust in the 1 to 10 micron range. Excessive exposure to this dust can overwhelm the natural ability of the body to defend itself which can lead to inflammation and swelling of the airways and this in turn can cause symptoms such as shortness of breath, increased sputum and coughing, frequent colds, nosebleeds, bronchitis and others sinus and respiratory problems. Wood dust can also contain allergens such as pesticides, molds and chemicals that can cause

allergic reactions. Tropical hardwoods can be especially irritating and as I already mentioned Western red cedar can cause allergic asthma.

Over the last 10 years I have helped hundreds of my students build over 500 guitars. A few years into this process I began to have flu and allergy like symptoms as we began the initial milling of the woods to build the guitars. The symptoms would subside somewhat as we got more into the hand tool work when shaping braces etc. However, they would return once again as we started sanding the instruments in preparation for finishing and the symptoms would go away altogether between semesters. Being the studious individual that I am, I quickly put two and two together, added 650mm (25.59 inches for you non metric folks) and some compensation and discovered it was the dust that was causing the symptoms I was experiencing. I soon realized that if I wanted to continue building guitars I had to address the problem head on and thus began my quest to get educated on the health hazards of wood dust. It was officially declared public enemy number one in my shop.

So, now that I had identified the problem, the next question was how to deal with it. The most obvious and quickest solution was to cover my nose and mouth. There are a couple of things to consider when it comes to a disposable mask. Firstly, how effective is the filter material? Secondly, how much dust gets in around the edges of the mask? If your dust collection is bad or nonexistent how much improvement is made by wearing a mask? Also, if you improve your dust collection capability is it still necessary to use a mask?

Ideally dust collection in the shop should begin at the source. Good dust collection at the source can reduce air borne dust to acceptable levels thus eliminating the need for a mask in the first place. Industrial hygienists, ACGIH, NIOSH, set the threshold limit values (TLV) for occupational woodworking at 1 mg/m<sup>3</sup>. This is for people working in the industry but we can certainly learn from it. If you have any doubts about your dust collection then wear an approved NIOSH mask. There are many themes and variations available and I prefer the ones that have a flap in them allowing me to exhale without fogging up my safety glasses. Well, they sometimes do still fog up but probably due more to operator error than the mask itself. These are available at most local hardware stores. If you can see a haze in the air in your workroom or you are finding layers of fugitive dust on your benchtops, horizontal surfaces and floors then it makes sense to wear an approved NIOSH rated respirator and improve your dust collection



Wearing a mask took some discipline on my part because communicating with students through a mask can be a problem. They also can never tell when I am smiling after delivering the punch line of the latest luthier joke like the difference between a violin and a fiddle. One has strings and the other has strangs. I digress.

The dust mask covered my nose and mouth but what about my eyes? Can dust in the eyes be a real health hazard or is it just irritating? A luthier friend of mine once had a severe eye infection due to dust exposure. So, the answer is a definite yes! I have always worn safety glasses in the shop but they don't really protect the eyes from the harmful small dust

particles floating around in our shops, the ones in the PM 10 range. You can use goggles or there are positive air flow face shields that can remedy this. I have used both. The full face shield eliminates the need for a dust mask. These are a bit more cumbersome and you must be disciplined making sure to use them when working. Once again, good industrial hygiene is when dust is effectively collected at the source. Several wood species are known human carcinogens when inhaled. Beyond that wood dust can be directly toxic. I therefore consider protecting the eyes from dust a valuable part of my dust collection repertoire.

Wearing a mask and eye protection were steps in the right direction and I noticed that these helped with my symptoms. However, the dust was still in the air as well as all over my shop. I had just put a filter between it and me. I felt I could still do more.

The next problem I decided to tackle was my shop vac. These have been around for years and until recently with the awareness of how bad wood dust can be for you have remained unchanged and very inefficient. The only thing between me and the dust was a very inefficient paper filter that still allowed the small dust particles to get into my shop environment and present a danger to me. The filter also clogged quickly lowering the efficiency of the vacuum itself. After some research I purchased the Dust Deputy system from Oneida Air Systems. *Disclaimer: I am a paying customer of Oneida Air Systems and contacted them to offer positive feedback after having purchased their products. Some of the information provided in this article was obtained from their website as well as through conversations with Oneida representatives.*



According to their website the Dust Deputy was going to transform the way I worked! Yeah right! The Dust Deputy Cyclone system is advertised to capture 99% of the dust before reaching my vacuum which meant that it would not reach the shop vac's filter clogging it within what usually seemed like a few minutes of operation. Finally someone understood my problem! In addition to the dust problem I had a shop vac problem! I often found myself reaching for the broom and

dustpan instead of taking my chances that my shop vac would be functioning at full capacity. After adding the Dust Deputy it actually became a pleasure to use my vacuum again and did indeed transform the way I worked when it came to my shop vac at least.

The idea behind a cyclone is that separation is done mechanically therefore keeping the filter clean. In other words the filter traps the small amount of super fine dust that is not separated by the cyclone so that air flow is maintained over extended periods of time. According to Robert Whitter of Oneida Air Systems, cyclone separation performance varies tremendously by cyclone design and application. In separation tests the Oneida Gorilla separated by weight 99 % (98.7%) of wood dust from a dual drum sander using 80 and 120 grit. This is a guideline for all Oneida cyclones. Only the smallest 1% of particles makes it through the cyclone and with an effective dust collection system they are then filtered so that they do not return to the work environment.

I also decided to add a Hepa filter in my shop vac. This way the small amount of super fine dust that does reach it can't get into my shop's airspace. What is a Hepa filter? It is a filter composed of a mat of fibers, typically fiberglass, arranged randomly. HEPA filters are designed to target much smaller pollutants and particles than regular filters. They are a bit more expensive than standard filters but well worth the investment. The filters are easily cleaned using air from an air compressor, however, many HEPA filters can't be cleaned completely so this is an important consideration when buying a filter. Oneida uses H-12 HEPA media made by GE. It is a more expensive hi-tech filter media but extremely efficient at filtering small micron material and easy to clean. You can just tap their Hepa filters to remove the dust.

Oneida recommends that people seek third-party lab test specs on the filter they are buying. A company should provide complete third-party lab testing specifications for their filters efficiency on their website. Oneida H-12 media filters 99.9 % of 1 micron and below. It uses a PTFE membrane (a Teflon- like coating) and makes available Third-party filter specifications on their website.

The small micron material in our shops makes up only a fraction of the total wood dust, but is the most unhealthy and needs to be filtered so that it does not return into the shop air. A Cyclone system is efficient at separating even small material and when used in conjunction with a high quality Hepa filter can greatly increase the dust collection efficiency as well filter cleaning intervals of your dust collection system. Typically it takes about 50 times longer to clog a cyclone system over a non- cyclone system.

I very rarely have to change the shop vac filter now as the Dust Deputy does indeed remove 99% of the dust before reaching the vacuum's filter. Finally I felt I might actually win the dust battle being waged in my shop. Could it be that the guitar building Gods were smiling upon me?

Up to this point I had taken a reactive approach to the problem. It was now time to take a proactive approach. The next logical step was to eliminate the dust at the source. The biggest particles and chips coming from machinery are easily removed with dust collectors. Once again it is the small particles that are the problem and not all collectors are created equal when it comes to removing and filtering these. The best solution would be a cyclone dust collector with the latest filtration technology. However, the elevated cost can be prohibitive even to the luthier that won the lottery. When asked what he would do with his winnings he said he would continue building instruments until it was all gone. Sorry, I couldn't resist.

Most of us probably have single stage dust collectors in our shops and in my case I have the old bag type. These have improved over the years with the introduction of filter canisters instead of the bags but still have their drawbacks. They have substandard filters that still do not trap the smallest particles, those in the PM 10 range. However, there are ways to improve the efficiency of these collectors. An inexpensive remedy is to make a homemade disk that works as a baffle keeping the dust in the lower bag from getting into the filter on top and clogging it. Fine Woodworking magazine No. 232 (April 2013) has a great article that even shows how to make the disk. It also discusses other ways of increasing the efficiency of your shop's dust collector.

In the shower one morning, ( I do my best thinking in the shower) I began to think of my single stage dust collector as a large shop vac. Like the shop vac it still had the problem of allowing the dust into the machine where it could wreak havoc on the filter and therefore my auto immune system thus decreasing the operating efficiency of both! If a second stage cyclone system worked to restore my shop vac to peak performance as well as keep 99% of the dust from even entering the machine in the first place then why not put something like that between my dust collector and the tool creating the dust? It seemed like a no brainer and apparently great minds think alike. Oneida had already created such a beast and named it The Super Dust Deputy!



So, for less than the price of buying another inefficient dust collector I am able to keep the dust from even entering the machine in the first place! Now I am getting somewhere! However, I am still limited to the amount of power that my single stage 1.5HP unit can provide and in most cases in my shop this is not enough. I have a 1000 sq. foot shop with almost a dozen machines hooked up to my dust collector. There is not nearly enough power to create enough airflow to efficiently remove the dust. After doing some research I realized that to remove dust and chips efficiently from the largest tools in my shops I need more than 500CFM (cubic feet per minute) of airflow. 500 CFM is a rough guideline for CFM requirements and can vary greatly depending on the woodworking equipment you are using.

So, I now have begun to educate myself on the myriad of systems available trying to find one that best suits me and my situation at a cost I can afford. The technical data alone makes my eyes glaze over as I read it. CFM (cubic feet per minute), SP (static pressure), single stage, two stage, cyclone system, PVC or metal duct work, 4 or 6 inch ducting, grounding, etc. The more I learned the more I would just open up another blast gate of questions needing to be answered. All I want to do is build guitars. I didn't know it would lead to this!

In my research I learned that there are basically four fundamental things that need to be addressed in order to effectively collect dust in your shop.

- 1. Collect the dust at the source.**

This is the most important aspect of effective dust collection. The dust needs to be collected and contained as it is being generated. If the dust you make gets into your shop's air then it becomes nearly impossible to collect and you end up breathing it.

## **2. Use sufficient air volume (CFM) at the woodworking machine.**

Most woodworking equipment in small shops needs between 50 and 500 CFM (cubic feet per minute) of airflow. Larger tools like planers and sanders need more. Insufficient air volume (CFM) at the tool allows dust from the operation to escape into the shop air. This is the most common mistake in dust collection. How efficiently you are collecting the dust at the tool can easily be determined by visual inspection. If the tool you are using loses a lot of chips and emits a plume of fine dust then you need to increase the hooding and/or CFM for that tool.

Typical causes of low CFM are small diameter hoses or ducting, fan blowers with low SP (Static Pressure), excessively long duct runs, and undersized filters. Static electricity buildup can also be a problem with dust collection systems. Oneida uses static dissipative plastics for their smaller cyclone designs and recommends that cyclones and plastic parts used for wood dust use these type plastics. Wood dust moving against non static dissipative plastic can create huge amounts of static electricity, zapping and shocking operators.

Dust collection systems and especially cyclone systems are far more complicated than they look. Even the overall size of the cyclone can affect the efficiency of the separation capacity of the system. Again, cyclone design can become very involved. A quick Google search will turn up a few cyclone engineering formulas and you'll see what I'm talking about. Many do it yourselfers and even other companies use Oneida's specifications as a model.

## **3. Separate the bulk of the waste from the line before it gets to the filter.**

If your system dumps all the dust into a filter it will clog quickly and thus reduce airflow and efficiency. This reduces CFM and the goal is to maintain sufficient air volume at the tool to prevent the dust from getting into the air in the first place. Even when running larger machines like planes and tablesaws small micron material is being produced and if not captured will become airborne. It makes sense to capture this material before it contaminates your working environment. Remember the example I gave of my shop vac? Once I installed the Dust Deputy Cyclone System it effectively removed 99% of the dust before it even had a chance to clog my shop vac filter. There are two types of inline separators: gravity drop boxes and cyclones. The drop box or barrel lid type removes heavier material and is generally about 50% efficient. A cyclone separator is much more efficient allowing only a small amount of very fine dust to pass to the filter. The smaller the dust particle the harder it is to capture with a cyclone. That said, cyclones can be amazingly efficient. Consider diesel trucks use a cyclone on the exhaust to filter out carbon particles. These are very small. An efficient cyclone design like the Dust Deputy will collect a high portion of this very fine material. An added benefit to inline separators is that they keep potentially destructive debris from entering the fan blower and causing damage or sparks.

## **4. Filter the fine dust.**

The final stage in effective dust collection is filtering the fine dust. Why go through all the trouble of collecting the dust just to blow the fine dust right back into your shop's environment due to poor filtration? Once it is airborne you are breathing it and remember it is the fine dust that is the most harmful. Effective filtration

requires two things, a quality filter media and a sufficient quantity of filter media. Ideally you want to filter near 100% down to the smallest particle. This means 99.9% of the dust in the PM10 range. HEPA filters provide the best possible filtration. These filters are typically associated with filtration of 99.97% efficient @ 0.3 microns. Filtering the dust and then venting outdoors can also be an option if you live in an area where you will not pollute your neighbor's breathing space. However, containment is generally the best practice. Emitting contaminants outside of a building is EPA jurisdiction. Also, if you are working in a conditioned space then heat loss can be a major factor.

My research into the health hazards of dust in the shop and how to deal with them effectively has been eye opening to say the least and my research is ongoing. At least now I have a general idea of what needs to be done and how to go about it. I will let you, the reader do your own research in order to find a system that best suits your dust collection needs. One thing I have learned is that there is a lot of hype and even misinformation and exaggerated claims about dust collection systems. I recommend you find a reputable company that concentrates solely on the design and manufacture of dust collection systems that remove and filter dust particles all the way down to the 1 and 2 micron range. When it comes right down to it common sense is the first indicator that you may have dust collection issues. Haze in the air, smell and layers of dust on surfaces in your shop indicate that improvement is needed. In my case adding a cyclone system and Hepa filters in my shop has not only helped keep my shop cleaner but also improved my health when working in my shop.

My main goal in writing this is to help others recognize the potentially harmful effects wood dust can have and then motivate you to take measures to reduce your exposure. The more I research and learn the more I realize that my current system is not doing enough to reduce my exposure to the dust in my shop. The problem I now have is I need to create more dust, and a lot of it, in order to be able to afford a new dust collection system!

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