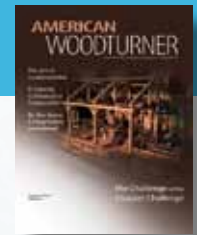
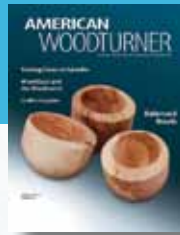


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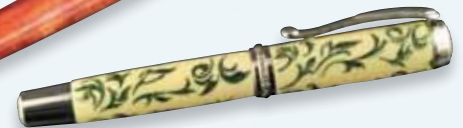
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# Wood Dust and the Woodturner

John English



The most complete protection is offered by full-face visor/mask/shroud systems such as Triton's powered ventilator, which was specifically designed for woodworkers.

At the U.S. Department of Labor, somebody has a cheerful way with words. According to the Occupational Safety and Health Administration (OSHA), "wood dust becomes a potential health problem when wood particles from processes such as sanding and cutting become airborne. Breathing these particles may cause allergic respiratory symptoms, mucosal and non-allergic respiratory symptoms, and cancer."

Of course there's a lot of truth in what OSHA is saying. And while the government is primarily concerned with people who create dust as a byproduct of their jobs, every woodturner is exposed to some level of risk. Even among turners, those risks vary. As humans grow older, we are less able to combat the effects of environmental hazards. For example, our lung capacity decreases as the elasticity of our lungs declines. And it's not just our lungs we should



Whether the dust collector has a fabric or a canister filter on top, it can usually be equipped with a clear plastic disposable collection bag below; this offers the distinct advantage of allowing the woodturner to see at a glance when the bag is getting full.

be concerned about. According to OSHA, "exposure to excessive amounts [of wood dust] is considered to have an irritant effect on eyes, nose, and throat, in addition to pulmonary function impairment, and is considered a human carcinogen."

We should make responsible decisions, so let's get informed.

## The nature of dust

Anybody who has perused *The Art of War* is familiar with the phrase "know your enemy." Writing in the sixth century, Sun Tzu, a Chinese military strategist, held a philosophy that is still widely taught; it is as applicable in a basement workshop as it is in a combat zone. The smart way to fight, according to Tzu, is to learn as much as possible about the enemy in order to create an advantage for yourself. So, let's do that by beginning with a discussion of the type of waste product that woodturners generate.

Turners create three distinct types of wood waste, and two of these are essentially innocuous. Large chips and gross dust particles are extremely difficult to inhale. While they may be hazardous as projectiles flying through the air, their collection and control is more a matter

of workplace tidiness than a health issue. Fine dust particles, on the other hand, can be dangerous, and this is the enemy that we need to learn about.

There are two aspects to fine dust that determine risk. First is the size of the particles, and second is the concentration of them in the air. Sawdust is generally in the area of less than 1 micron to 600 microns in size. A micron ( $\mu\text{m}$ ) is one-millionth of a meter ( $1/25,400$  of an inch) in diameter. To put that in perspective, particles smaller than 40 microns cannot be seen with the naked eye. Our lungs deal well with foreign bodies that are more than 7 microns in size. So, when a ray of sunlight reveals floating dust in the shop's air, we're only seeing particles that are five or six times larger than the ones that can hurt us. Those invisible enemies are so small that our natural respiratory filters can't catch them.

But size isn't everything. The number and concentration of particles in the air is the real key. Jobsite exposure to wood dust causes significant increases in respiratory problems at exposure levels as low as  $2 \text{ mg/m}^3$  (just 2 milligrams per cubic meter). The National Institute for Occupational Safety and Health (NIOSH) recommends exposure limits that are half that:  $1 \text{ mg/m}^3$ . So, here's a sobering thought: Sanding a bowl with fine grit paper produces a concentration



Many smaller dust collectors now offer canister filters rather than fabric ones. The filters replace the top fabric bag and any buildup of powdered dust can be removed by simply turning a lever (on top), instead of trying to beat the dust from the inside of a bag.



several hundred times the NIOSH level in the immediate vicinity of the work.

It is not just the cellulose debris that needs to be addressed. Adverse health effects also come from biological organisms such as mold and fungi that grow on or in the turning blank. Scraping and sanding wood while it is on the lathe will release these particles, and will also free the residue from adhesives used in segmented or repaired work. Furthermore, concentrations of wood dust may create a mixture with air that can explode and will also burn readily if ignited by a spark or flame.

The government has come up with a lovely acronym for this weighty topic: LEV (local exhaust ventilation). LEV describes the three main dust solutions available to turners: powered masks and helmets, ambient filters (those large, ceiling-hung boxes that scrub the shop's air), and dust collectors/shop vacuums equipped with filters to handle fine particles. The latter is the most effective and perhaps the least understood of the three, so let's begin there.

### Dust collectors and shop vacuums

Dust collectors are all about volume, while shop vacuums are into speed. Dust collectors pull large amounts of air through their

Oneida has created an aftermarket add-on cyclone that can be attached to a single-stage dust collector, in effect transforming it into a two-stage unit that separates the dust from the chips. A two-stage filter keeps filters cleaner and more efficient, and is easier on impeller fan blades.



filters, while shop vacuums have more suction but move far fewer cubic feet per minute (cfm). Power in both types of

machine is measured in terms of static pressure, which is the ability to pull up water in a controlled test. A dust collector can raise a column of water about a foot up a tube, while a shop vacuum can pull the same column perhaps five times as high.

However, the average woodshop dust collector has a 4" or 6" (10cm or 15cm) inlet and it will move between 650 and 2,000 cfm, while a shop vacuum hose is only 2½" (64mm) in diameter and can pull less than 200 cfm (and about a quarter of that with a smaller, 1¼" [32mm]-diameter hose). A typical one-car garage workshop contains about 2,000 cubic feet of air. A larger dust collector can filter that much air about once a minute, while an average shop vacuum

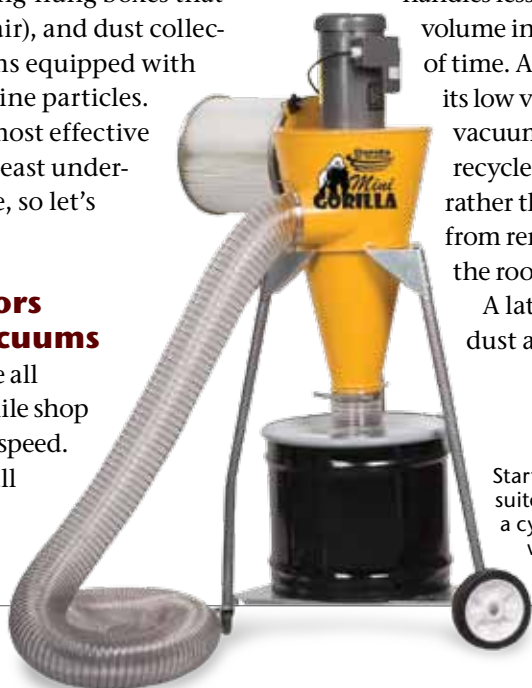
handles less than 1/10 of that volume in the same amount of time. And because of its low volume, the shop vacuum will primarily recycle air close to it, rather than scrubbing air from remote corners of the room.

A lathe generates dust about halfway

between the floor and the ceiling in most shops, so the contaminants are well distributed through the workshop and especially around our mouths and noses. During turning, sandpaper is static while the work revolves, and that motion tends to spread the dust around. Because of its small hose and ▶



Collectors equipped with two pairs of bags are designed to share a single, larger motor. The airflow is split, allowing twice the room for waste in the lower bags and twice the amount of fabric filter in the upper ones.



Starting at just 1 HP, the Mini-Gorilla dust collector from Oneida is ideally suited to space-challenged shops, where a turner needs high efficiency, a cyclone separator, and 600 cfm of airflow to collect the fine and coarse waste from a single lathe.



Combining the benefits of cyclone separation with an exterior two-stage filter and a large debris bucket, the 2 HP Super Gorilla from Oneida is a unit well suited to turners who take on larger bowl projects, and therefore need more than one dust port.



Oneida Air System's portable collector is designed for woodworkers and turners who don't have a central dust collection system with lots of ductwork already in place. The cyclones create a vortex that uses centrifugal force to separate dust from chips.

lack of volume, a shop vacuum is fairly ineffective at collecting fine particles around a lathe, no matter what kind of dust port is used on the end of the hose. It'll get the big bits, but the harmful ones can enter our lungs.

On the other hand, dust collectors usually force the air back into the room through a large fabric bag rather than through a small cylindrical filter. The weave on the bag determines what size particles are returned to the room. Bags are available aftermarket for most collectors, and many handle dust down to one micron or less. There is a point of diminishing returns, where the filter openings are so small that they restrict the airflow to the point that the dust collector loses much of its volume. For most machines, that watershed is in the neighborhood of one to two microns, while some manufacturers recommend staying above four microns, just to maintain airflow. Some of the high-end shop vacuums now come with cartridge filters that will scrub the air down to a very respectable level. These high efficiency particulate air (HEPA) filters are required to remove at least 99.97% of airborne particles 0.3 microns in diameter. However, they simply can't handle high volume, and that's what turners need to address their dust.

Storage is important, too. A shop vacuum's waste tank is generally in the 5 to 10 (20 to 40L) gallon range, while a dust collector bag doesn't need to be emptied until it has accumulated several times that. Many are even set up for 30- or 55 (110- or 210L)-gallon drums. That encourages people to use the machines. Nobody wants to stop working every few minutes just to empty a dust bag.

There's one more health concern with shop vacuums: most models are very noisy. However, there are mufflers made for most shop vacuums, including a fairly universal one from Sears.

The bottom line is that dust collectors serve turners better than shop vacuums, primarily because of the

sheer volume of waste that we generate and the number of air exchanges we require to protect ourselves.

### Selecting a dust collector

The critical numbers to look for in a dust collector are volume and static pressure. Volume is described in cubic feet per minute (cfm). While the horsepower rating gives some indication of a unit's abilities, different manufacturers measure horsepower in different ways and that often leaves the woodturner comparing apples to oranges. But the volume of air that a fan can move is a fairly reliable number.

If the lathe is the only tool hooked up to a dust collector, or all the other machines can be isolated with blast gates so that only the lathe is being served, a collector with volume in the 600 to 1200 cfm range is quite adequate for most work, if it isn't located too far away. Turners with large bowl lathes who are turning vessels that exceed 16" (41cm) or so in diameter will need more volume.

The second half of the equation, static pressure (SP), can be confusing. For example, Grizzly offers an excellent two-horsepower cyclone dust collector (model G0440) that pulls



The Dust Deputy from Oneida turns an ordinary shop vacuum into a two-stage unit, where the larger particles are sent to the bucket and the fines are trapped and collected in the unit's standard bin.



Filtering up to 1,400 cfm, the G9956 from Grizzly can scrub all the air in a two-stall garage shop in an impressively scant three minutes, providing twenty changes an hour. It runs on a 1/3 HP, 110-Volt motor with remote and three speeds.



Weighing just 18 lb (8kg), this freestanding version of a ceiling-mounted whole-shop filter is offered by Shop Fox. It filters down to an impressive 0.3 microns, and because it is unattached, it can be placed close to the lathe, especially during sanding tasks.

Ceiling-hung shop air filters such as Grizzly's G0572 usually have a remote control for the three-speed motor, an automatic timer, and two filters (in this case a 5- and 1-micron). The 1/5 HP motor runs on standard 110 Volts.

1,354 cfm at 2.5" (6cm) SP. That is, it moves 1,354 cubic feet of air per minute at 2.5" (6cm) of static pressure (the amount of suction required to raise a column of water that high). However, the specs on this machine also note that the maximum SP is 10.4" (26cm). In other words, the machine will not move air at a higher suction level. The key here is that, as the static pressure rises, the volume of air falls. So, when comparing two dust collectors, one needs to compare their volumes (cfm) at the same SP. If a salesperson is touting an impressively high volume of airflow, the odds are that he or she is not mentioning a very low suction rating.

Beware of a SP number that is quoted without cfm. If a machine is rated at, say 16" (41cm) SP, it's a safe bet that this is the maximum SP it can generate, and at that pressure there is absolutely no airflow. The bottom line is that a good two-horsepower dust collector should be able to draw about 1,500 cfm at 12" to 14" (30cm to 36cm) maximum SP; a three-horsepower unit should handle 2,000 cfm; and a four-horsepower machine should be in the 3,500 cfm range.

Aside from airflow, some other design aspects are worth noting. Two-bag collectors have a filter bag on top and a collection bag on the bottom. Four-bag units simply double the filter and collection areas. Clear poly bottom bags (as opposed to canvas ones) really help, as they make

it immediately obvious when the collector needs to be emptied.

Machines with canister filters have a pleated filter instead of a fabric bag, and the big advantage here is that, when dust cakes on the inside, it's just a matter of moving a handle to knock it loose and regain full airflow. The canister filter is usually made of polyester, and many filter down to less than 1 micron. The pleats allow for a larger filtering surface in a smaller physical area.

A cyclone dust collector has a large funnel-shaped plenum that forces the incoming air to swirl in a circle, so that large and small particles are separated by centrifugal force. In general, there is a canister for large chunks and a bag for fine particles. For turners, there isn't a whole lot of advantage, considering the extra expense, as we generally don't create large waste on the lathe. A more budget-sensitive solution is to create a two-stage collector by adding a garbage can and a special lid to a single-stage unit (the lids are available at [nosawdust.com/cyclone\\_lid.htm](http://nosawdust.com/cyclone_lid.htm)).

### **Ambient filters**

These are also known as air scrubbers or whole-shop filters. They most often take the form of rectangular, ceiling-hung metal boxes with a fairly powerful fan that is located behind one, two, or even three stacked filters. The salient factors

Several manufacturers now offer custom and aftermarket high efficiency filters for shop vacuums and most of them are capable of trapping more than 99% of the small particles that cause pulmonary problems.

to consider when choosing one of these air filtration systems are the same as those used to decide on a dust collector: how much air does it move, and how efficient are the filters? The higher the volume (cfm) on the outfeed side of the unit, the quicker it will scrub the air in your shop. Try to find a unit that will recycle the cubic feet in your space (length × width × height in feet) at least every ten minutes.

Most of the newer units come with a remote control, which is handy for people who are less than 7' (213cm) tall. They usually have three speeds (in the neighborhood of 400, 600, and 800 cfm), and will cycle the air in a ▶

A freestanding dust port that has its own independent, adjustable stand and a wide funnel-shaped mouth is ideal for collecting dust on the lathe. These units can be placed so close that they almost touch the work, and angled upward a little to catch falling chips.







The 11121 Lathe Dust Hood from Big Horn Corporation has a hinged, clear viewing shield that swings completely out of the way. It comes with universal mounting brackets for a custom fit on many different brands of lathes, and it works with a 4" (10cm) hose.

two-car garage between five and ten times an hour. There are generally two filters, a coarse one that collects dust in the 5-micron plus range, and a fine one that works all the way down to 1 micron or less. Better models come with timer settings (they can be run for several hours and then they shut down automatically), and the motors are almost always 110 V that generates less than 1 HP, so they can be plugged into a standard ceiling or wall outlet. (Make sure the ceiling outlet isn't designed for lighting, and is controlled by a switch.)

Depending on the thickness of the sheet metal housing and the size of the motor, ambient ceiling-hung filtration systems weigh between 40 lb and 80 lb (18kg and 36kg), so they need to be anchored soundly to the underside of floor joists or trusses.

For some very impressive guidelines on building an inexpensive, shopmade

Lightweight face and lung protection is provided by three sizes of battery-powered ventilators offered by the 3M Company, the 6700, 6800 and 6900PF masks.

ambient filter and downdraft sanding table combo, visit [woodworkersworkshop.com/plansshare/air\\_filter\\_downdraft\\_sanding\\_table.htm](http://woodworkersworkshop.com/plansshare/air_filter_downdraft_sanding_table.htm).

### Pressurized dust masks

In addition to running a collector, a great many turners now wear a pressurized mask system (also called a powered respirator) while sanding or doing other tasks that produce dust or vapors. These units can seem a bit pricy, but they work very well. There are two types: a small breathing mask that pumps air out faster than the operator can breathe it in, and a full-face unit that incorporates a Plexiglas face screen, and sometimes a helmet, too. The latter provides face protection from impacts, and allows the user to wear eyeglasses without fogging. Beards can be a problem with conventional dust masks, but they're not an issue with most powered respirators.

Perhaps the most popular respirator is one made by the Australian company, Triton. This is more of a system than just a mask: it has a helmet designed to guard the head from impact, a faceshield to save eyes from flying debris, and a shroud and filter to protect lungs from fine dust. The shroud is a soft plastic fabric that rests on the shoulders, sealing the bottom of the system.

The key component in Triton's respirator is an air filter that sucks in air through a belt-mounted, battery-operated filter that hangs on the user's waist. The batteries are rechargeable. The filter usually

contains two or three separate filters that meet US N95 NIOSH standards (P2 in Australia). They eliminate up to 99% of the dust particles that are under one micron in diameter, and 95% of particles down to 1/3 of a micron in size. At around \$210, Triton's system delivers 4.23 cfm without any accessories. For more information, visit [tritontools.com](http://tritontools.com).

Smaller versions of the powered respirator are available. One of the more popular ones is made by the U.S.-based 3M Company (3M.com). The company refers to its model 6800PF mask as a Powered Air Purifying Respirator. It uses a single filter and delivers four cfm of clean air. The system includes a faceshield, motor blower unit, belt, battery pack, flow meter, and high efficiency filter. A small version (6700PF) and a large one (6900PF) are available. Typical prices run about \$400.

Wearing a powered respirator feels a bit strange at first, but it doesn't take long to get used to it. Most are quite lightweight and ergonomic. There's a small rush of claustrophobia the first time it's worn, but once the air starts moving and the face shield stays clear of fog, it actually feels reassuring. One wouldn't wear it to the grocery store, but in the private confines of a workshop, this strange garb is literally a lifesaver and can extend the joyful years of turning. It can help avert the onset of numerous pulmonary problems, and can also help make turning possible for folks with asthma, mild emphysema, various allergies, and susceptibility to dust-related illnesses.

### Dust masks: A word of caution

One of the great misconceptions of dust control is that inexpensive white

Inexpensive nuisance masks offer virtually no protection whatsoever against fine sanding dust, and lull some turners into feeling so safe they don't use a dust collector.





The Dust Bee Gone reusable dust mask is available in several sizes.

fabric or paper nuisance masks offer some protection while turning. It's worth noting that reputable companies such as 3M place a warning label on their version of these, and it literally reads: "*This mask will not protect your lungs.*" (Less scrupulous manufacturers print the label in small print on the package rather than the mask, or not at all.) Nuisance masks not only allow almost all of the dangerous small particles through, they also impart a false sense of security. People using them for wood dust filtration feel as though they are doing something to

protect themselves (which, of course, is completely false), so they don't bother taking any other real steps such as installing an air scrubber, hooking up to a dust collector, or investing in a powered respirator.

Beyond the cheap, disposable versions, there are some nuisance masks such as the Dust Bee Gone that, although not NIOSH or OSHA approved, still filter down to 3 microns. The mask accommodates to most faces, even those with beards, has two straps to help close gaps around the edges, won't fog up glasses, and is actually made in America. For more information, visit [dustbeegone.com/dustmask.html](http://dustbeegone.com/dustmask.html).

After all is said and done, woodturners who take precautions against inhaling wood dust will be able to enjoy their time at the lathe without fearing respiratory health hazards. The consequences of exposure are just too risky to take casually. ■

Many additional fact sheets and articles on the hazards of wood dust exposure can be found online at a number of websites, among them:

Ohio State University Extension Service  
[ohioline.osu.edu/aex-fact/0595\\_1.html](http://ohioline.osu.edu/aex-fact/0595_1.html)

State Compensation Insurance Fund  
[scif.com/safety/safetymeeting/Article.asp?ArticleID=125](http://scif.com/safety/safetymeeting/Article.asp?ArticleID=125)

WoodBin Woodworking  
[woodbin.com/misc/wood\\_dust\\_toxicity.htm](http://woodbin.com/misc/wood_dust_toxicity.htm)

Health and Safety Executive  
[hse.gov.uk/pubns/wis1.pdf](http://hse.gov.uk/pubns/wis1.pdf)

*John English is the author of The Woodworker's Guide to Sharpening and How to Choose and Use Bench Planes. He teaches furniture building and cabinetmaking at the Black Hills School of Woodworking.*

*For additional information, see AW, vol 16, no 2, "Wood Dust," by Pat Matranga and vol 21, no 4, "Battling Dust," by Peter Fedrigon.*

## Dust control Malcolm Zander

In a past issue of *AW*, I described the use of a polyethylene sheet tent around the lathe to isolate the dust and shavings from my workshop (vol 22, no 4). This enclosure keeps the workshop clean, but I still have to stand inside the tent and breathe sanding dust—even with the best dust extractor system.

To help remedy this problem, I bought a Triton powered respirator helmet (upgraded from a now-defunct Racal helmet), but found that the daily cleaning and replacement of the inlet air filters was a major hassle. So I eliminated the belt-mounted battery pack/fan/filter and replaced it with clean air ducted in from another room in the house.

Clean house air arrives through a 5" (125mm) duct that is connected to a 200 cfm bathroom-type blower in

another room of the house. A furnace filter is placed over the fan intake.

By using standard plumbing hardware, the ducting diameter is reduced to 1¼" (30mm) to fit the Triton hose. The central vacuum hose extension allows me to reach anything within a 10' (3m) radius of the lathe with good ease of movement.

The duct run is 20' (6.5m) long. To give the proper airflow rate required inside the respirator, a 200 cfm (5.7m<sup>3</sup>/min) blower with a squirrel-cage

centrifugal fan (as opposed to an axial fan) was needed to overcome the resistance of the ducting and the smaller diameter hose restriction.

This system blows clean room-temperature air directly into my helmet. When sanding, I am unaffected by the dust cloud inside the tent. The respirator is comfortable and very quiet, and I wear it virtually all the time when turning. One additional advantage to this setup is that when my wife is baking muffins in the kitchen I can tell within seconds.

(A condensed version of this article was published in *Woodturning*, September 2008, p. 51.)

In order to see the duct setup, I have removed the plastic tent around the lathe.

