



Choosing a Shop Vacuum Cleaner

Air watts, cfm's, peak horsepower? When the dust settles, filter material and placement of wheels may be more important items to consider

by Michael Standish

Until an allergic reaction to redwood put me in the hospital for two weeks, I used to chase sawdust with a broom. Even though sweeping seemed to put more of the stuff in the air than it did in my dustpan, it was the best cleanup method I had. After my failed experiment with using lungs for dust collection, I went out and dropped \$600 for the best shop vacuum cleaner I could find, money that I think was well spent.

The machine I bought was light and compact, so it was convenient to use on a regular basis. It was also powerful, and its filter trapped fine dust particles. I reckoned then that its high purchase

price had become part of the cost of the job. My vacuum is now over five years old, and today, similar performance is available for less than half of what I paid. Although there are hundreds of so-called shop vacuums on the market, I recently looked at a dozen machines from well-known manufacturers that were advertised as being suited for contracting or carpentry work, in the shop or on the job site (photo above).

Vacuums vs. dust collectors—Shop vacuums basically consist of a motor-driven fan that draws debris-laden air in through a hose (draw-

ing facing page). Larger debris is collected in a canister, and the air is drawn through a filter, which is supposed to trap finer debris. The filter on a shop vacuum is between the intake port and the fan, which is what chiefly distinguishes these machines from portable dust collectors, which typically trap dust as air is exhausted.

Another difference worth noting is that dust collectors typically move larger amounts of air at slower speeds than shop vacuums. The air movement in both machines lets heavier debris (wood chips and shavings) drop to the bottom of the container before reaching the filter. This

preparation, filter location and lower air volume make a shop vacuum ideally suited for picking up liquids because droplets of water tend to behave in the same way as heavy wood chips, falling out of the airstream and filling up the canister.

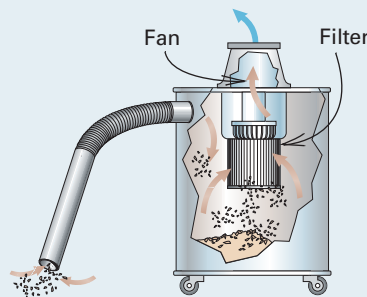
The ability to clean up spills without a mop and pail can be a great convenience (and a godsend for plumbing repairs that require dry copper). But although a shop vacuum may be perfect for sucking up your tears on April 16, its classical use still remains janitorial—cleaning up dust and debris.

For picking up sawdust from floors and especially out of nooks and crannies, a shop vacuum excels. It's fast and efficient, and unlike cleaning unplugged (that is, using the old-fashioned broom), a vacuum doesn't usually raise an accompanying cloud of debris. But beware: Such apparent cleanliness may turn out to be an illusion. If the filter on the vacuum is too coarse, small particles of dust actually can pass through, turning that cleaning machine into a retrograde dust blower.

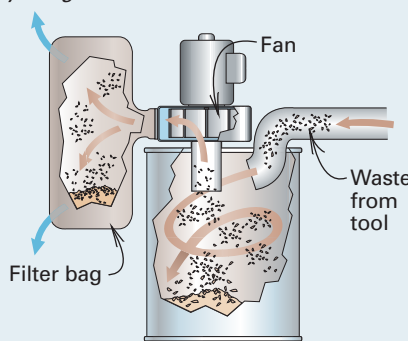
This consideration also applies when picking up sawdust directly from a tool, a sound but all-too-uncommon practice. At the very least, woodworking waste is a major nuisance that needs to be cleaned up at some point, so it's always made sense to me to gather it as it's being produced. Convenience aside, dust collected straight from the machine is dust not breathed (sidebar p. 79).

Two ways of cleaning up

Shop vacuums. They typically move smaller volumes of air at high speeds for picking up waste from floors as well as from tools. After heavy debris drops out of the airstream, the fine dust is filtered from the air before it passes through the fan.



Dust collectors. They usually move large volumes of air at slower speeds, making them ideal for gathering waste straight from the tool. Heavier debris drops into a canister. Then the air passes through a fan, and fine dust is filtered by a bag as the air is exhausted into the room.



The wrong filter can ruin a vacuum motor—The standard unit used to gauge hazardous dust is the micron, which measures about 40 millionths of an inch. Under optimum backlit conditions, the smallest particle visible to the naked eye is around 1.25 microns. The human body copes fairly well with particles larger than 10 microns. These particles are filtered by nasal hairs or caught in the mucous that lines the respiratory tract. Particles smaller than 10 microns, however, can be readily breathed deep into the lungs, where they can cause irritation or permanent damage (*FHB* #88, pp. 72-77).

But whether dust is measured in millimeters or miles doesn't matter particularly. What does matter is that many construction operations (i.e., sawing, drilling, routing wood) produce visible waste that's large enough to be easily trapped by any decent shop vacuum's filter. This dust is generally no smaller than 30 microns in diameter.

However, the dust produced from working with masonry and drywall or from power-sanding wood is often as small as 1 micron to 2 microns. If the work you do typically produces the most harmful and least visible waste, you'll need a vacuum with a filter that actually captures these particles rather than just blowing them back into the air.

But to trap fine dust, a filter must function without caking up so much that the dust interferes with proper airflow. These somewhat contradictory requirements are best met by providing the filter with the largest possible surface area

A tank-liner filter fits over the top of the vacuum tank. A washable cloth tank liner separates the fan from the tank on some vacuums to filter the air. Fein's vacuum (shown here) also has a prefilter bag, so the tank liner acts as a secondary filter.



Foam-sleeve filter is just for sucking up water. When Eureka's vacuum is used for dry work, a paper bag slips over the foam filter and is held in place with an elastic band.

A prefilter bag makes emptying easier. Vacuums such as the Porter-Cable have a disposable paper bag that fits over the intake port to prefilter the air. The bag also acts as a receptacle for dust and debris.



A pleated-paper cartridge has the biggest surface area for filtering. Looking a lot like an automotive air filter, pleated-paper filters attach directly to the fan housing. The aftermarket filter on the left traps extremely fine dust particles.

SHOP VACUUM CLEANERS



A manometer measures air pressure. A manometer was hooked up in the airstream of each vacuum to measure the suction (negative air pressure) on each machine, which provided common ground to compare the machines.

Model	Price	Cord length	I.D. hose dia.	Hose length	Fan	Noise level	Manometer reading	Filtration	Comments
Dayton #2Z564F (800) 473-3473	\$193	12 ft.	1.5 in.	7.5 ft.	Two stage	88 dB	1.7 (115 cfm)	Pleated cartridge	Sold through the Grainger catalog
Delta 49-2255 (800) 438-2486	\$225	7 ft.	2 in.	6 ft.	Single stage	85 dB	1.9 (121.5 cfm)	Paper bag over cloth sleeve	Dry vac only; casters extra
Eureka 2832 (800) 282-2886	\$89.99	6 ft.	2 in.	6 ft.	Single stage	92 dB	1.25 (98.5 cfm)	Paper bag over foam sleeve	In-board casters less likely to snag
Fein 95513 (800) 441-9878	\$325	16 ft.	1 in.	16 ft.	Two stage	72 dB	2.1 (127 cfm)	Prefilter bag; tank liner; foam disk	Tool-activated switch for dust collection
Hoover S6755 (330) 499-9200	\$189	12 ft.	1 in. and 2 in.	6.5 ft.	Single stage	93.5 dB	3.4 (162.5 cfm)	Pleated cartridge	Double tank for separate wet/dry work
Jet JV-10 (800) 274-6842	\$479	18 ft.	1.5 in.	12 ft.	Two stage	91.5 dB	2.25 (132 cfm)	Tank liner; pleated cartridge	Hand-truck wheel configuration
Makita XSV-10 (800) 462-5482	\$564	17 ft.	1.5 in.	12 ft.	Two stage	79 dB	1.2 (96.5 cfm)	Pleated cartridge	Stainless-steel tank
Milwaukee 8926 (800) 414-6527	\$947	30 ft.	Sold separately	Sold separately	Three stage	83 dB	2.2 (129 cfm)	Prefilter bag; tank liner	Largest wet/dry capacity (21 gal.)
Porter-Cable 7810 (800) 487-8665	\$460	25 ft.	1 in.	13 ft.	Two stage	85 dB	2.6 (142 cfm)	Prefilter bag; pleated cartridge	Tool-activated switch, electric wet shutoff
Royal 081600 (800) 321-1134	\$99	20 ft.	2 in.	7 ft.	Single stage	95.5 dB	4.3 (183 cfm)	Pleated cartridge	Motor detaches for leaf blowing
Sears 17700 (800) 377-7414	\$99	15 ft.	2 in.	7 ft.	Single stage	93 dB	5.2 (219 cfm)	Pleated cartridge	Most powerful vacuum tested
Shop-Vac 92568 (717) 326-0502	\$192	17 ft.	2 in.	8 ft.	Single stage	83 dB	4.8 (193 cfm)	Paper disk over foam sleeve	Quietest vacuum for the money

(the larger the area of the filtering material, the longer it takes to be blocked.) To capture the most dust, a filter's fineness and area count for more than what the filter is made of.

No matter what vacuum you own or buy, always use a filter recommended by the manufacturer. The wrong filter can deprive the machine of the necessary amount of intake air, which is needed to cool the motor and keep the vacuum's innards from being cooked. A vacuum can also be choked from a clogged filter or from running the machine after its shutoff valve for wet vacuuming (usually a simple ball-check or float) has engaged. Conversely, some vacuum cleaners operated without filters can run too fast for the cooling fan with similarly dire results.

Not all filters are the same—Looking downstream from the vacuum's intake port where the hose plugs in, you can expect to see all sorts of filters, used either by themselves or in combination with other filters. Vacuums such as the Fein and the Porter-Cable have a disposable paper bag attached directly to the intake port that serves as a prefilter (photo bottom left, p. 75).

These prefilter bags make for tidy and convenient waste disposal. But these paper bags also can be punctured easily by shards of wood, loose screws and other sharp-edged debris.

Some vacuums such as the Milwaukee, the Jet and the Fein come with tank liners (photo top left, p. 75), cloth filters that fit prophylactically over the top of the tank. A tank liner has a large surface area, so it works well either as a prefilter or as a main filter. Plus, being made of cloth, tank liners can easily survive frequent washings.

Another type of prefilter is a paper or cloth bag that slips neatly over the main filter element. Eureka's vacuum has a small paper bag (photo top right, p. 75) that mounts over a foam sleeve (the paper bag is supposed to be removed for picking up liquid). Shop-Vac has a similar arrangement, except that instead of a paper bag, a large paper disc is pressed over the foam sleeve. A plastic ring keeps the disc in place. Delta's machine (for dry vacuuming only) has a paper-bag prefilter that slips over a cloth sleeve that functions as the primary filter.

The most common filters that are used on shop vacuums are accordion-pleated canister

cartridges that attach directly to the fan housing (photo bottom right, p. 75). Like their automotive cousins (engine air filters), these filters used in shop vacuums put the largest surface area in the smallest space. Accordion-pleated cartridges are usually made of heavy-duty paper that can be washed and reused. I was unable to track down much definitive information about the particle size that stock vacuum filters will trap. However, an extremely efficient aftermarket cartridge is available called the CleanStream Filter (W. L. Gore and Associates; 800-758-6755), which is 99.7% effective at trapping 0.3-micron particles, just 0.3% short of the high-efficiency particulate air (HEPA) rating, but at a lot cheaper price. CleanStream filters are made of durable synthetic materials that can undergo repeated washings.

A quick word here about emptying a shop vacuum, which can inspire anything from Three Stooges hilarity to pure existential despair, depending on who is left in the dust. Here is where those disposable prefiltering bags earn their keep a second time by keeping all the debris nicely contained. But if prefiltering bags are un-

available for your machine, take heart. An after-market product called the Vac Sac (908-262-0447) is available and lets you use a heavy-duty plastic garbage bag to line the vacuum canister. The dust and debris are conveniently collected in the garbage bag, which unfortunately takes all the fun out of watching the new guy do the emptying.

Unscrambling the ratings—Reading the labels, badges, shipping cartons and owner's manuals of a dozen shop vacuums provided me with fine insights into the creative process that tool manufacturers apply to performance claims. For example, Eureka and many others rate their machines by peak horsepower, which turns out to be the most power a motor can deliver, however briefly, under optimum conditions. Still others such as Shop-Vac include a sealed-pressure rating, which is a measurement taken with the intake blocked.

Both of these rating systems yield such huge numbers that I anticipated testing machines in terms of Einstein's theory of relativity: As the vacuum's motor reaches the speed of light, its mass becomes infinite, leaving nothing in the universe to be cleaned. In the real world, however, shop vacuums are often operated for fairly lengthy periods with the intake open to pick things up at comparatively down-to-earth operating speeds.

Even the more common, less flamboyant values that manufacturers use to rate their machines don't make comparing the tools any sim-

Emptying a shop vacuum can inspire anything from Three Stooges hilarity to pure existential despair.

pler. In addition to the usual horsepower ratings, the consumer also has to wade through air watts, miles per hour, cubic feet per minute (cfm) and inches of airlift. To be fair, all the items in this annoying hash are legitimately related to vacuuming. In any given vacuum cleaner, a motor drives a fan that moves air, performing work (measured in watts or horsepower). The moving air has velocity (mph), and a given amount of this air flows over a given period of time (cfm). The force that is exerted by the moving air can be indexed to the atmospheric pressure (airlift).

The problem is that each of these values can be manipulated to support claims of superiority by manufacturers. For my testing purposes, I chose the manometer, basically a graduated water level about as complicated to read as a thermometer, which measures air pressure (photo

page). A shop vacuum's job, after all, is to collect debris using pressurized air.

I tested each machine straight from the box with the dry-vacuumping filter setup recommended by the manufacturer. With the manometer connected in the airstream, I took readings while the shop vacuums were free-running for at least one minute. What this method may have lacked in laboratory rigor, it made up in fairness. Relevant measurements were obtained under uniform circumstances, leveling the playing field for all the machines. Also, testing the machines with a manometer cleared a path through the manufacturers' hype.

In addition, I used each machine under both job-site and shop conditions to make evaluations in a less formal way. I found that all the machines were more than adequate in general use, i.e., they all picked up solids and liquids efficiently (the Delta is a dry vacuum only). In fact, to satisfy my own curiosity, I timed the machine that had the highest manometer reading (Sears) and the machine with the lowest (Makita) to see how long each took to suck up a gallon of water and a gallon of planer shavings. The difference amounted to their taking 7 seconds and 11 seconds to pick up the water and 6 seconds and 9 seconds, respectively, to suck up the planer shavings. The point is that unless you need to save 3 minutes or 4 minutes to clean up each 55-gal. drum's worth of debris, you may want to use criteria other than raw-suction power when selecting a shop vacuum. As with any tool, there are tradeoffs in efficiency, longevity,



A double tank means changing from wet to dry instantly. Instead of having a filter that requires changing when switching from wet work to dry work, the Hoover vacuum has a separate built-in tank for each function.

Choose your weapon. In addition to a flexible hose, most shop vacuums come equipped with wand extensions as well as a standard floor tool, a crevice tool and a squeegee attachment for picking up water.



convenience and initial cost that you should make according to your own needs.

The least expensive machines are the loudest—Almost half of the shop vacuums I looked at were from well-known manufacturers. Dirt Devil, Eureka and Hoover are as common in a house as Sears/Craftsman is in a shop, while the Shop-Vac brand lends these machines their generic name, like Coke for cola drinks. This group of shop vacuum cleaners was the least expensive and, except for the Eureka, most powerful bunch, but they were also the loudest.

I checked each machine with a sound meter, and some produced noise readings consistent with an industrial table saw in full song. The Shop-Vac machine with its foam-insulated motor casing was a notable exception. The worst offender was Royal's Dirt Devil, which, aside from having the highest decibel reading, also gave off a particularly shrill, piercing tone.

All the machines in this group come amply equipped with extension tubes (for the hose) and an array of nozzles (photo right, p. 77). Most of these machines had their casters mounted well outboard of their canisters, providing a stable base but furnishing excellent toe-catchers. Eureka hides its five furniture-type casters conveniently under a canister that flares out at the bottom, eliminating the toe-catchers while maintaining pretty good stability.

Hoover has a unique approach to wet/dry vacuuming. Their machine has two tanks, one for

Some vacuums produce noise consistent with an industrial table saw in full song.

water, one for dust (photo left, p. 77). Each tank has a separate intake, and a small panel on the outside of the machine slides to change from one tank's intake to the other's. Separate tanks eliminate the need to change or remove filters when switching from wet to dry vacuuming. The Hoover also has a convenient tank drain for emptying the water tank.

Most of these machines are made primarily of plastic, but all seemed to work quite well. They are also inexpensive enough to be viewed as the proverbial cowboy's nag: Buy it, run it into the ground, replace it.

Vacuums from major tool manufacturers—

The next group I looked at consisted of offerings from major tool manufacturers, Dayton, Delta, Jet, Milwaukee and Makita. Made by companies with expertise and experience in manufacturing and servicing industrial-strength equip-

ment, these machines seemed to be built tougher and made for the long haul. All but two—the Milwaukee and the Delta—have metal canisters. (Delta's fiberboard canister is meant for dry vacuuming only.) All but the Delta feature two-stage bypass fans that usually mean quieter operation, and the second fan offers heavy-duty cooling capability for sustained use.

The Milwaukee and the Delta both have large canisters (the Delta holds 28 gal. to Milwaukee's 21 gal.). But a large canister can be a mixed blessing. Although these machines can pick up quite a large amount of debris before they need to be emptied, you still have to lug around the weight of all that extra debris until you empty the canister. Milwaukee mercifully put a drain in their tanks so that you don't actually have to lift the machine to empty it when it's full of water (photo bottom left). Plus, the large-capacity tanks make these machines a bit cumbersome, especially if you have to haul them from site to site in your pickup.

The wheels on the machines in this category seem better suited to job-site abuse. Each one—except the Delta, whose four drum-mounted casters are optional—has large rear wheels and a tubular-steel hand-truck type of handle, making it easy to drag the machines over rough job-site terrain or over wood scraps on a plywood subfloor. However, the Jet, Makita and Dayton machines all have just a single front wheel.

While the Jet and Makita come with a goodly amount of sturdy-looking metal extension

Smaller hoses get clogged more easily. Shop vacuums come with different-size diameter hoses, from 1 in. to 2 in. Because the smaller diameter hose moves air more quickly, it is better at sucking up fine particles. But it's also more apt to get clogged by coarse debris.



A tank drain saves your back. Milwaukee's vacuum has a large 21-gal. capacity, which is convenient except when emptying the machine. To get around this problem, the company installed a drain in the bottom of the tank.



A different type of wet shutoff. Most shop vacuums have a float ball that seals off the fan intake when the tank is full of water, but the motor still runs until the switch is turned off. Porter-Cable uses two electrodes that complete a circuit and turn off the motor when the tank is full of water.

wands, and pickup attachments for many specific tasks, the Dayton, Delta and Milwaukee are somewhat Spartan when it comes to accessories. The Milwaukee vacuum comes with no hose, on the reasonable assumption that the buyer would want to choose from their large selection of hoses, adapters and kits for everything from automotive detailing to furnace cleaning.

The machines in this group all use a 1½-in. dia. hose, except for the Delta's 2-in. hose, which was typical of the first group. The smaller diameter means greater airspeed (at a given volume of moving air), which makes these machines excel at collecting finer dust particles (photo top left, facing page). But smaller hoses are more readily clogged by larger chips.

Two vacs ahead of the pack—While all the machines I tested were at least satisfactory, two stood out as my distinct favorites. The Fein and the Porter-Cable were trim, light, powerful and quiet. But what really distinguished them was that they offered features rather than accessories.

Both have tool-actuated switches for collecting dust from power tools. The tool plugs into the vacuum, which is activated when the tool is switched on and runs for a few seconds after the tool is turned off, a convenience if you're doing direct dust collection.

The disposable prefiltering paper bags that come standard on both the Fein and the Porter-Cable make for quick and tidy emptying of the canister. The Porter-Cable is loaded with other nice touches such as a foot-operated parking brake, a flipper that ruffles the pleats to knock dust off the main filter and a slick shutoff for wet pickup. When the canister is full, liquid contacts two electrodes in the vacuum head, completing a low-voltage circuit that shuts off the motor (photo right, facing page).

The German-built Fein was the Mercedes of the group. It was far and away the quietest machine I looked at, quieter than many household vacuum cleaners. The Fein's superior engineering resulted in utterly smooth operation of everything from its casters to its switches.

The Fein comes standard with a collection bag rated at 5 microns, but dust-laden air is further filtered through a tank liner and a foam disk placed directly over the fan intake. Fein is planning to offer an optional filter this fall that will trap even smaller particles. □

Michael Standish is a carpenter and writer who lives in Jamaica Plain, Massachusetts. Photos by Roe A. Osborn.

Shop vacuums as dust collectors

Dust and debris make life on job sites harder in many ways, from being a nuisance to posing a severe health hazard. So if it's possible, I use my shop vacuum to collect sawdust and debris directly from the tool as the dust is being produced.

with a plate joiner, a router cutting a groove or a stopped drill, dust pickup is easier because the wood left around the cut acts as a preliminary dust chute. A router-table fence can also collect the waste from even the deepest edging bits.



Vacuuming dust before it hits the floor. Many tools such as this miter saw are equipped with dust-collection ports easily adapted to vacuum hoses. The Porter-Cable vacuum is switched on automatically when the saw is turned on.

Normal shop vacuums can be easily overwhelmed by tools that have lots of cutting edges (circular saws, table saws and miter saws), or by tools that have few edges moving at high speed (routers). Successful dust collection from these machines depends on the cutting you're doing. If the cut goes all the way through the work, as in ripping on a table saw, the main problem is where collection should take place because dust is being thrown on both sides of the table.

On the other hand, if the cutting is only partial, as

Many tools now come from the factory with shrouding and porting for dust bags or canisters. This built-in ducting is easy to connect to the hose of a shop vacuum, which will gather a surprising amount of debris even from such notorious churners as belt sanders or miter saws (photo above).

I hooked up the tool-actuated vacuums to a 10-in. miter saw that had a dust-exhaust port. I then used tape to attach the hoses to the port. Even with this temporary rig, the vacuum sucked up nearly all the sawdust from each cut.

If a built-in attachment is lacking, a swiped vacuum nozzle (even a PVC fitting) can be cobbled up for a vacuum-hose hookup. Some of these Rube Goldberg setups can be cumbersome if the hose adaptation gets too involved, and dust-collection results will vary with the tool and the operation.

If you're hell-bent on dust collection, as I am, there are alternatives to the standard shop vacuum cleaner. Shop-Vac's Tool Mate is a compact, lightweight, portable dust collector. As a true dust collector, it collects dust and debris in a cloth bag mounted downstream from the fan. The Tool Mate boasts a 25-gal. capacity and is mounted on casters, so it is easy to move around, and it can be bought for around \$250. The Tool Mate moves a lot of air, so it also works well as a vacuum cleaner. With only a coarse cage for fan protection, though, the blades may be subject to damage from screws or other unfriendly debris that might be sucked up.

Two other dedicated machines for dust collection, Makita's 420S backpack machine and Sears' Tool Vac, are designed especially to collect debris from tools, but each has the filter configuration of a shop vacuum. Like the Porter-Cable and Fein machines, both of these machines can be activated automatically when the dust-producing tool is plugged in and turned on. The Makita and the Sears have limited capacity, but they are light and portable, making them ideal for overcoming the inherently clumsy nature of collecting dust from portable tools, i.e., being tethered to a hose and an additional machine.—M. S.