

Dust Collection for the One-Man Shop

How to get the most performance from 1-hp to 2-hp dust collectors

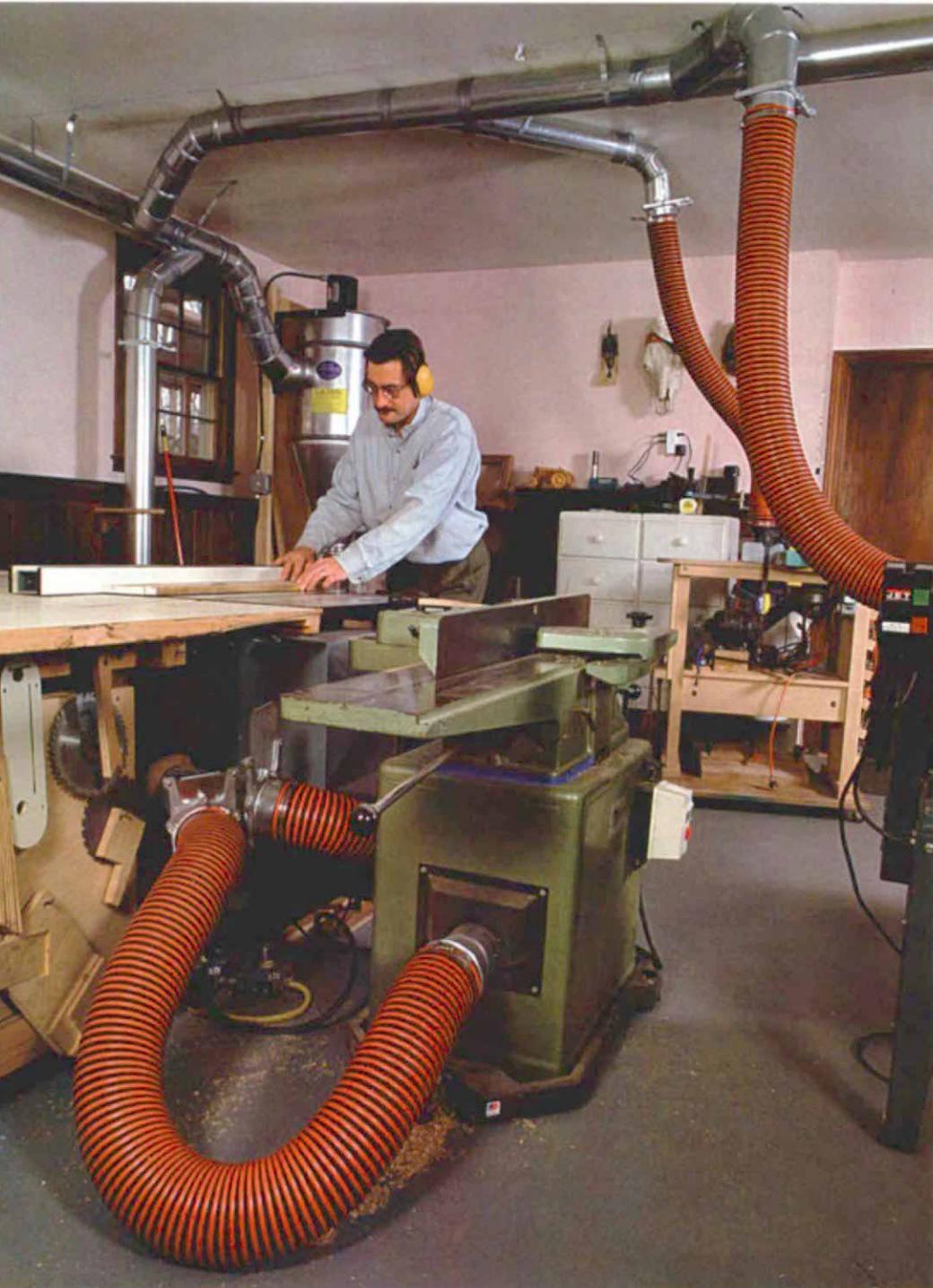
BY ANATOLE BURKIN

Don't throw away the broom just yet. Even the best dust-collection system won't eliminate the need for occasional sweeping. A good system, however, will keep the broom and your lungs from wearing out prematurely.

There are two main points to consider when choosing a dust collector. First, figure out the air-volume requirements of the machines in your shop (see the chart on p. 84). Next, decide on what kind of hookups you are going to use: flexible hose, PVC pipe or metal duct.

To see what size and type of collector would best suit a one-man shop, I gathered a sampling of machines, from 1-hp single-stage units to 2-hp two-stage collectors, including one cyclone: Delta (1 ½ hp single stage), Dust Boy (2 hp two stage), Jet (2 hp single stage), Oneida (1 ½ hp cyclone) and SECO UFO-90 (1 hp single stage). I used the collectors with my tools, which include a 10-in. cabinet saw, a 15-in. planer, an 8-in. jointer and a 16-in. bandsaw.

The horsepower rating is a fairly reliable guide to the performance of a dust collector (see the chart on p. 85). Hookups, however, are everything. Too much flexible hose will rob even a big collector of power. PVC pipes, in short runs, work fine with a sufficiently powered collector, 1 ½ hp or more. Metal duct, not unexpectedly, performs best. Even an 8-year-old, 1-hp col-

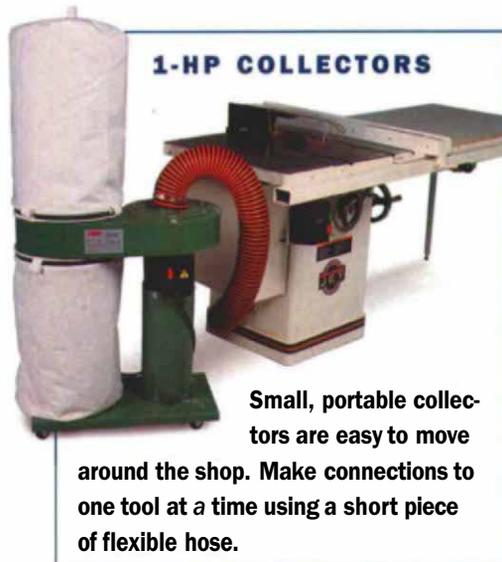


Three styles of dust collectors

lector can collect chips from machines 25 ft. away when hooked up to a properly designed system. Using a 1-hp collector this way may seem misguided, like putting a racing exhaust system on a subcompact car, but the experiment illustrates how you don't have to spend a fortune to get decent results. Every shop is different, of course, and your results may vary, so use my findings as guidelines, not absolutes.

A 1-hp single-stage collector can handle any machine in my shop

The biggest sawdust producer in my shop is a 15-in. planer. And even a 1-hp single-stage dust collector can handle that machine, hooked up with about 6 ft. of 4-in.-dia. flexible hose. I borrowed a new UFO-90, same as my old collector, to see if anything had been changed. It's still the



Small, portable collectors are easy to move around the shop. Make connections to one tool at a time using a short piece of flexible hose.

same machine, rated at 650 cu. ft. per minute (cfm) by the manufacturer, but when hooked up to 6 ft. of flexible hose, it moves about 420 cfm. That's slightly less than the 500 cfm recommended for a 15-in. planer, but 90% of the time the 1-hp collector can handle it because I rarely plane 15-in.-wide stock.

One-hp single-stage collectors cost about \$200. Some woodworkers buy two units and station them strategically in their shop. At 82 decibels (measured at 8 ft.), a 1-hp dust collector isn't much noisier than a vacuum cleaner, and each one takes up about 3 sq. ft. of shop space.

I also used the 1-hp collector with a PVC duct system (4-in.-dia. pipe and fittings) and measured the moving air volume at the table saw-jointer connection, which is

The most economical and biggest-selling dust collectors are the two-bag, single-stage models. Single stage means the dust is sucked through the impeller (fan) and dumped into the lower bag. The upper bag collects fine sawdust and lets the exhaust air back into the shop.

Two-stage collectors are the next step up. The motor and impeller sit atop a barrel. Chips enter the barrel and are directed downward, although the swirling air inside may occasionally move smaller chips upward. A filter bag hangs off to one side and collects the finest dust.

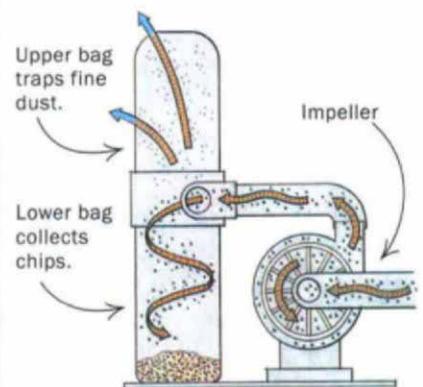
Two-stage cyclones are at the top of the evolutionary chain. The motor and impeller sit atop a cone-shaped canister, the cyclone, which is connected to a trash can below. Chips or other large debris enter the cyclone and swirl downward, avoiding the impeller. The longer the cyclonic chamber, the greater its effectiveness at slowing down and separating large particles. Air is filtered either by a pleated internal cartridge or by one or more felt bags hanging off to the side of the machine. Internal-cartridge cyclones use the least amount of floor space. The upper bags or cartridge filters of all collectors must be shaken out occasionally to remove fine dust.

DANGERS OF SINGLE-STAGE COLLECTORS
Debris entering a single-stage collector passes through the impeller, many of which are made of steel. Even a small bit of metal, such as a screw, can cause a spark when it hits a steel impeller. Dust-collector explosions are rare, but the potential is there. Debris, metal or otherwise, not only makes a racket when it hits an impeller but also imparts stress on the bearing and will shorten its life. I heard of a woodworker whose collector's sheet-metal housing was punctured by a screw that entered the impeller.

One way to reduce the risk of fire is to choose a single-stage collector with a plastic or aluminum impeller. Although the impeller itself won't cause a spark, metal debris striking the steel housing may have the same effect. Steel impellers are fine, however, if you avoid using the dust collector to sweep up miscellaneous debris off the floor or workbench.

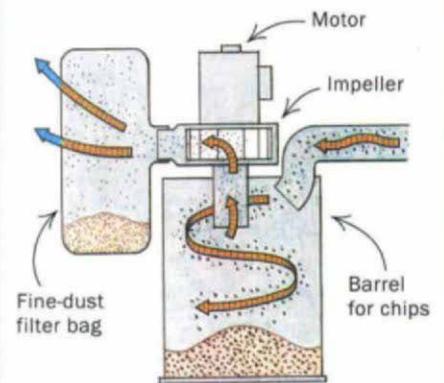
SINGLE STAGE

Sawdust must first pass through the impeller (fan) before being separated.



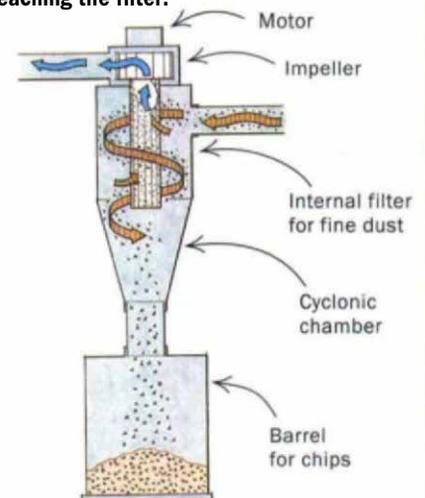
BARREL-STYLE TWO STAGE

The larger chips entering a two-stage collector tend to drop out before they have a chance to strike the impeller.



TWO-STAGE CYCLONE

The shape of a cyclone is most efficient at slowing down the speed of debris, allowing most of it to settle out before reaching the filter.





Although collectors in this power category may occasionally be used with two tools simultaneously, for best performance, use blast gates and run one tool at a time.

at the end of about 25 ft. of pipe and hose. At that distance, because of increased resistance, the air volume drops to under 300 cfm, less than recommended for woodworking tools. In reality, however, one can live with that. But if I'm face-jointing wide boards, the collector can't always handle the volume, and chips jam the jointer's dust port. Maybe 80% of the time it works okay.

When I hooked up the 1-hp collector to a newly installed metal duct system, with my tools in the same configuration as before, I was really surprised. The air volume was back up to 360 cfm, very acceptable. Then I hooked up my old 1-hp collector, which is outfitted with oversized felt bags (available from Oneida Air Systems) that improve airflow and capture fine dust (see the story below), and I measured almost 400 cfm. That's a significant gain.

A 1 1/2-hp collector can be hooked up to longer runs of hose or duct

As you might imagine, hooked up to one machine at a time, a 1 1/2-hp collector does

Go with felt bags.

The standard bags issued with most dust collectors are good for capturing particles of 25 to 30 microns or bigger. A micron is 1/1,000,000th of a meter in length; looked at another way, the paper this article is printed on is about 25 microns thick. Fine dust blows right through filter fabric, back into the shop.



Fabric vs. felt. A fabric bag, left, has less thickness and is more porous. Felt, right, does a much better job of filtering out very fine dust.

not have any trouble removing chips, even with a long (12-ft.) run of hose. Delta rates its 1 1/2-hp collector at 1,200 cfm, a number that is derived in a lab, not under real shop conditions (for more on manufacturer specs, see the story on the facing page). Hooked up to a 6-ft. run of 4-in.-dia. flexible hose, I measured about 500 cfm with the Delta and 470 cfm using an Oneida Air Systems 1 1/2-hp cyclone collector. Cyclones and two-stage collectors have slightly more internal air resistance; hence the lower cfm reading. That's about what you can expect from any 1 1/2-hp collector hooked up to 4-in.-dia. hose.

I also hooked up the 1 1/2-hp collectors to two machines running simultaneously. Performance ranged from good to so-so, depending on how much sawdust was being spit out by my tools. The best way to direct maximum airflow to the tool being used is to attach a blast gate to each hose.

Hooked up to a PVC duct system (a run of about 25 ft. of pipe), both the Delta and Oneida collectors captured most of the sawdust when running one tool.

A 1 1/2-hp Delta collector costs about \$350. A two-stage unit such as the Oneida costs almost twice as much. Penn State Industries also sells a cyclone collector. (For more on the advantages of two-stage collectors vs. single-stage units, see the story on p. 83.)

Both 1 1/2-hp collectors performed exceptionally well when connected to metal duct and used with one tool at a time. With two blast gates open, the air volume dropped and was insufficient to operate two big machines at once.

The larger-volume bags or canisters of 1 1/2-hp collectors hold a lot of material, about 30 gal. worth, which means fewer trips to the compost pile, a big advantage over the 1-hp machines that hold about

Dust particles under 10 microns in size are the most harmful because they can get past the respiratory tract and enter your lungs. Unless you wear a dust mask while woodworking, toss out the stock bags and replace them with felt bags rated at 5 microns or less.



Measurements were taken with a dial-gauge manometer (a pressure gauge) and pitot tube. The chart at right compares the performance of a few dust collectors when using hose, PVC pipe and metal duct.



AIR-VOLUME REQUIREMENTS OF MACHINES

TOOL	CFM NEEDED
10-in. tablesaw	350
6-in. or 8-in. jointer	300-450
12-in. planer	350
15-in. planer	500
Drill press	350
14-in. or 16-in. bandsaw	350
Radial-arm saw	350-500
12-in. disc sander	350
12-in. to 24-in. drum sander	300-500
Oscillating spindle sander	350
Floor sweep	350

DETERMINING YOUR DUST-COLLECTION REQUIREMENTS

PERFORMANCE OF DUST COLLECTORS UNDER VARYING CONDITIONS

Horsepower	6 ft. from collector, 6-in.-dia. straight metal duct*	6 ft. from collector, 4-in.-dia. flexible hose	6 ft. from collector, two runs of 4-in.-dia. flexible hose	25 ft. from collector, at jointer hookup, 4-in.-dia. PVC pipe	25 ft. from collector, at jointer hookup, 5-in.-dia. metal duct
1 hp single stage	550 cfm	Excellent	Fair	Fair	Excellent
1½ hp single stage	825 cfm	Excellent	Good	Good	Excellent
1½ hp cyclone	700 cfm	Excellent	Good	Good	Excellent
2 hp single stage	980 cfm	Excellent	Excellent	Excellent	Excellent
2 hp two stage	825 cfm	Excellent	Good	Good	Excellent

Fair: under 300 cfm Good: 325 cfm to 350 cfm Excellent: more than 350 cfm

* Bags or filters attached with a light coating of sawdust present.

MAKING SENSE OF MANUFACTURER SPECS

There's a fair amount of misleading marketing specs on dust collectors. When an ad says a collector is rated at 1,200 cfm, what does it mean? Not much, really. Cfm stands for cubic feet per minute, a measure of the volume of air moving past a point of reference. The cfm figure needs to be put in the context of the amount of resistance, or friction, present (called static pressure, or SP). Air moving through duct or hose encounters resistance, just as a person would slipping down a water slide. The more bends and bumps, the slower the ride or the lower the air velocity and volume. Many manufacturers rate their machines without bags or duct attached.

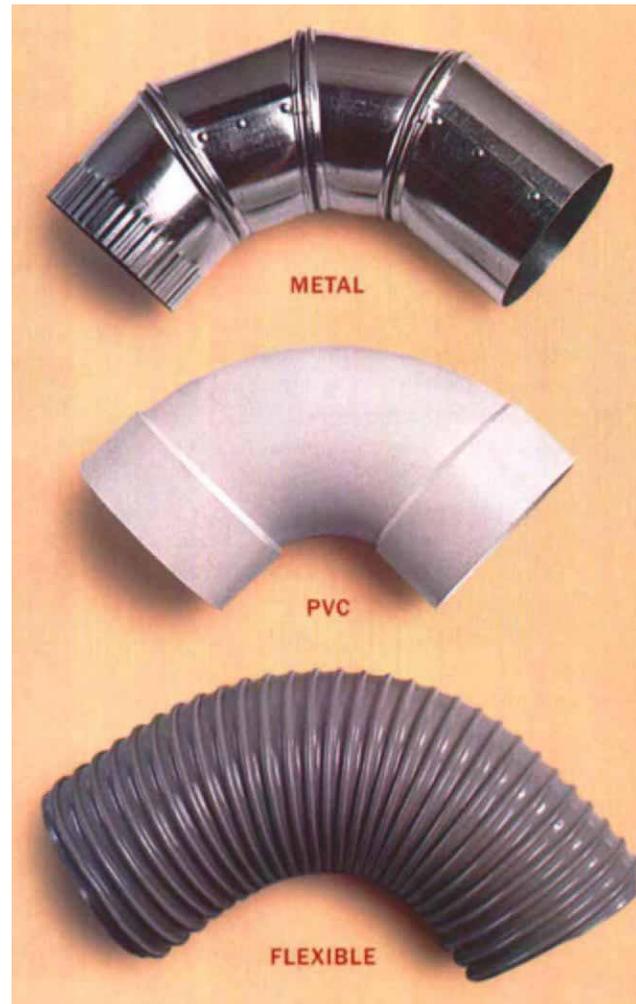
While trying out a number of dust collectors, I measured their performances under real working conditions, using flexible hose, PVC pipe or metal duct in my 420-sq.-ft. shop (see the chart above). The resistance readings ranged from 3 in. to 5 in. I also measured collectors hooked up to a

straight piece of 6-in.-dia. metal duct, just to get a baseline, highest-possible performance figure.

Collectors ranging in size from 1 hp to 2 hp have impellers (fans) sized from 10 in. dia. to 12 in. dia. All things being equal (motor speed and impeller design), a bigger impeller coupled with a bigger motor will move more air than a smaller pairing. There are some differences among collectors; to learn more, ask a manufacturer for an impeller performance chart.

As soon as any collector is hooked up in the shop, performance declines in relation to the length and type of hookup. That's why smooth-walled metal duct, with wide-radius elbows and wyes, is better than PVC pipe.

Materials that affect airflow. *The metal elbow (top), which is designed for central dust-collection systems, has a gentle sweep, which lowers resistance to airflow. Plastic PVC pipe has a tighter-radius bend and restricts airflow more. Ribbed flexible pipe also disturbs airflow, up to three times as much as metal.*



2-HP COLLECTORS

SINGLE STAGE

Many 2-hp collectors can handle two tools at once. Although 4-in.-dia. PVC pipe is not the best duct material, satisfactory results can be obtained when connected to a 2-hp collector.



BARREL-STYLE TWO STAGE

A 2-hp collector has enough power to handle larger machinery, such as this 18-in. planer (right). This collector by Dust Boy is a two-stage model with a 55-gal. drum.

half of that. A 1½-hp single-stage collector takes up about 7 sq. ft. of shop space. But a vertically stacked two-stage cyclone such as the Oneida takes up only 3½ sq. ft. of shop space, a big plus in a small shop. More horsepower does mean more noise; both registered 85 decibels at 8 ft. The Delta comes wired for 115 volts but can be switched over to 230 volts. The Oneida comes without cable or switch. It can be wired to run on either current.

A 2-hp unit can sometimes handle two machines at once

Hooked up to two 6-ft. runs of 4-in.-dia. hoses, a 2-hp single-stage collector draws over 350 cfm from each port, plenty for many woodworking machines. The 2-hp two-stage Dust Boy didn't match the power of the 2-hp single-stage Jet machine, although it has other qualities that may be preferable (see the story on p. 83). When I connected the 2-hp units to the PVC duct system, they too were robbed of considerable power, but one machine could be operated at a time with satisfactory results.

When connected to a metal duct system, the Jet collector really moved a lot of air, 570 cfm at the tablesaw-jointer connection (after about 25 ft. of duct). With two blast gates open, the air volume was reduced to less than 300 cfm, still acceptable for some operations. The Dust Boy produced slightly lower readings but still had more than enough power to run one tool at a time in any configuration. If you regularly operate more than one machine simultaneously, it

would be wise to look at 3-hp or bigger dust collectors.

The 2-hp machines are no noisier than the 1½-hp collectors. They cost more, however. The Jet is priced at \$400; the Dust Boy sells for about \$650. Most 2-hp collectors come wired for 230 volts. The Dust Boy can be run at either 115 volts or 230 volts.

Choosing among the options

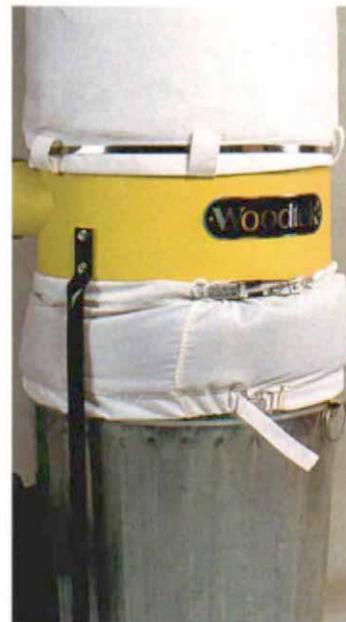
On the matter of choosing a dust collector, a two-stage cyclone gets my top vote. A small cyclone collector takes up less room, is easy to empty and runs very clean. For example, on all of the single-stage units, even after running them for only an hour,

fine dust appeared on the machine and in the area around it. That's because it's difficult to get a perfect seal between the bag and housing. The Oneida cyclone, outfitted with an internal filter, rubber gaskets and wide metal ring clamps, seals better.

Two-stage units such as the Dust Boy (Delta also makes a two-stage collector) are also nice and compact. The Dust Boy takes up 6 sq. ft. and less vertical space than most collectors. The Dust Boy (as does the Oneida) comes with a Leeson motor and cast-aluminum housing and impeller (fan), and the sturdy plastic barrel holds a lot of debris, 55 gal. worth. Before it can be emptied, however, the heavy motor and housing must be lifted off.

Removing the lower bag of a single-stage collector is an easy matter of loosening a band clamp. The real fun begins when you try to reattach it. If you've ever had to put your pants on with an arm in a cast, you'll get the idea. The lower bag must be wrapped around the metal waist of the machine and held in place before the clamp can be cinched. Some manufacturers, such as Jet, add an elastic band inside the lower bag to facilitate reattachment somewhat.

Woodworker's Supply tried to solve the lower-bag problem with a clamp-on skirt accessory. The skirt and a standard 30-gal. trash can replace the lower bag. Because the skirt remains attached to the collector's housing, it's easy to cinch the lower belt that attaches the skirt to the trash can. I just wish the skirt were made of felt rather than the more porous woven fabric. This setup



Better connections. The Oneida cyclone collector's trash barrel is connected by a large metal ring, which simplifies reattachment (left). Woodworker's Supply sells a clamp-on skirt accessory that is used with a 30-gal. trash can (right). The skirt is easier to reattach than a standard lower bag.



Designing a central dust-collection system

Oneida Air Systems designed my ductwork, which is very typical for a one-room shop under 500 sq. ft. The ductwork begins with a 6-in.-dia. pipe connected to the collector. At the first wye (split), the duct reduces to 5-in.-dia.

branches. The 5-in.-dia. pipes serve the biggest tools (jointer, tablesaw and planer), even though they all have 4-in.-dia. dust ports, which ensure good air volume to the machines. Also, you can change the dust port to a 5-in.-dia. connection for better performance. A 5-in.-dia. to 4-in.-dia. reducer is used to make the transition.

The 4-in.-dia. branches that split off the 5-in.-dia. line serve smaller tools, such as the bandsaw and router table. Blast gates are installed at each tool. The final connections were made with flexible hose, which allows me to move my tools around.

I used 24-gauge (mostly) snap-lock pipe, spot-welded fittings and aluminum blast gates, which are available from many companies. (Avoid lighter-gauge metal duct designed for heating or cooling systems; it can collapse under vacuum.) A higher-quality system will employ 22-gauge spiral pipe and welded fittings, which are stiffer and more airtight, and yes, they cost more. Quick-Fit duct supplies from Nordfab are also premium priced, but the components go together easily and don't require duct tape or caulk.

Although individual 24-gauge components aren't that expensive (a 5-ft. run of 5-in.-dia. snap-lock pipe costs about \$8), it all adds up. A very basic three-machine

setup may be had for a few hundred dollars. A system for half a dozen tools and a floor sweep may cost \$500 or more.

To help illustrate the photos in this article, an orange/black flex hose was used to make connections from pipe to tools; black flex hose, however, works fine. It's best to use a minimum of hose

because it produces about three times the friction of metal pipe. Friction will reduce the performance of the system. All pipe seams and connections must be sealed with caulk or duct tape. Clear silicone caulk is a good choice because it's virtually invisible and is easy to remove.

DESIGN HELP IS AVAILABLE

Designing the ductwork for a central dust-collection system can involve a lot of calculations. For those of us who skipped math class, there's help available.

- Air Handling Systems of Woodbridge, Conn., has an on-line duct calculator program (www.airhand.com). The company outlines the concepts of duct design in a four-page brochure.

- Oneida Air Systems of Syracuse, N.Y., will design a duct system free of charge for its customers (www.oneida-air.com). All that's required is a shop drawing showing the types and locations of woodworking machines.

- Nordfab of Thomasville, N.C., manufacturers of the Quick-Fit line of duct and fittings, offers a free design service. The company has a downloadable program (www.nordfab.com), but you need a CAD program to run it. The company also offers a peel-and-stick shop layout kit for analog woodworkers.

- If you wish to tackle duct design yourself, all of the necessary information can be found in *Woodshop Dust Control* by Sandor Nagyszalanczy (The Taunton Press, 1996).

SOURCES OF SUPPLY

AIR HANDLING SYSTEMS (800) 367-3828
Duct supplies and duct design

AMERICAN FABRIC FILTER CO. (800) 367-3591
Custom-made dust bags

DELTA (800) 438-2486 Dust collectors

DUST BOY (800) 232-3878 Dust collectors

HIGHLAND HARDWARE (800) 241-6748
Dust collectors

JET (800) 274-6848 Dust collectors and supplies

KRAEMER TOOLS (800) 443-6443
Dust collectors and supplies (Canada)

LENEAVE MACHINERY (800) 442-2302
Dust collectors

NORDFAB (800) 532-0830
Quick-Fit duct supplies

ONEIDA AIR SYSTEMS (315) 476-5151
Dust collectors, duct supplies and duct design

PENN STATE INDUSTRIES (800) 377-7297
Dust collectors and supplies

POWERMATIC (800) 248-0144 Dust collectors

SUNHILL MACHINERY (800) 929-4321
Dust collectors and supplies

WOODWORKER'S SUPPLY (800) 645-9292
Dust collectors and supplies

WILKE MACHINERY (800) 235-2100
Dust collectors and supplies



No screws or rivets needed. Quick-Fit duct pipe from Nordfab is assembled using gasketed clamps.

will reduce the air volume (the collector "breathes" through both bags) when using the stock upper bag. With a larger upper bag, I found that the cfm readings were not compromised. But if you happen to vacuum up any offcuts, they will make quite a racket rattling around in a metal trash can.

Although many woodworkers, myself included, have used PVC drainpipe for duct

without mishap, experts warn against using the material. The connectors (elbows and wyes) restrict airflow, and the material builds up a static charge, which may cause a spark and set off an explosion. (Running grounded copper wire inside the pipe reduces the hazard.) Use PVC at your own risk. Metal duct and fittings are obviously better and will also last longer. I've broken

half a dozen plastic blast gates in as many years. If you're on a tight budget, go with flexible hose or build a metal duct system in stages, starting with only a couple of hookups. Your collector will work more efficiently, and so will you. □

Anatole Burkin is a senior editor of *Fine Woodworking*.