Small-Shop Dust Collectors

Choosing the right features and power for your needs

by Sandor Nagyszalanczy

Even woodworkers with no natural housekeeping skills eventually may recognize that the sawdust piling up on the shop floor is a nuisance. Sawdust is also a fire hazard and, worse, poses serious health risks. Some of the bits of dust pumped into the air are many times smaller than the human eye can detect. Dust particles that small can stay aloft for hours, plenty of time to be inhaled and lodge in the deepest cavities of your lungs. Exposure to dust over long periods of time may even give you cancer.

These are good reasons to have a central dust-collection system. A well-designed system whisks wood dust and debris from the machinery, work stations and floor sweeps to a canister or bag. Good-quality filters capture most of the dust before the air is returned to the shop. Any small particles that sneak through can be controlled with an air-filtration device or by wearing a dust mask. The result is a healthier and cleaner shop.

You can get good results by mounting a collector on a dolly and wheeling it from job to job. But I think a central collection system—consisting of a collector, rigid metal ducts and flexible hose—is the best approach. A good central collector is tailored to suit the equipment in your shop.

Central collectors vs. shop vacuums

Shop vacuums or small portable collectors work well when collecting dust from a single machine or from portable power tools. But many of them don't have much chip-holding capacity. A shop vacuum has a small universal motor, like those that are used in most portable power tools, running at a high speed to drive a fan that draws sawdust through a 1-in. to 2¼-in. flexible hose. Hoses that small can clog easily with large shavings.

A central collector is like a big shop-vacuum cleaner, with some important differences. A central collector employs a pow-

Photos except where noted: William Duckworth

erful induction motor (the kind used in most stationary machines) to drive a large-volume fan. This blower, or impeller, moves chips and sawdust through ductwork 3 in. to 6 in. or more in diameter. A central dust collector moves a large volume of air at 3,500 to 4,000 feet per minute (fpm)—a speed just high enough to keep chips and dust moving through the ducts in a well-designed system.

In contrast, a shop vacuum moves a small volume of air at a high velocity—8,000 fpm or more—through a small-diameter hose. This high-velocity air is subject to more friction, which is why these machines quickly choke if you try to draw sawdust through more than just a few feet of hose.

Two-stage systems are safer and more efficient

Once you've decided to buy a central dust collector for your shop, you are faced with a number of choices. The most basic is whether to go with a single-stage or a two-stage design (see the drawings at right). Prices range from less than $200 for a 1-hp single-stage version to more than $2,500 for a big-capacity two-stage collector.

Single-stage collectors are widely advertised in woodworking-supply catalogs and magazines, and most of them are manufactured in Taiwan. These simple devices consist of a blower and a filter-bag assembly (see the top photo at right). Incoming dust and chips travel through the blower and then into fabric bags. The lower bag collects the sawdust.

A two-stage collector removes larger particles and coarse dust before air enters the blower. Most two-stage collectors use either a canister or a cyclone (more about cyclones later) to separate heavier debris. Only fine dust moves through the blower and into the filters.

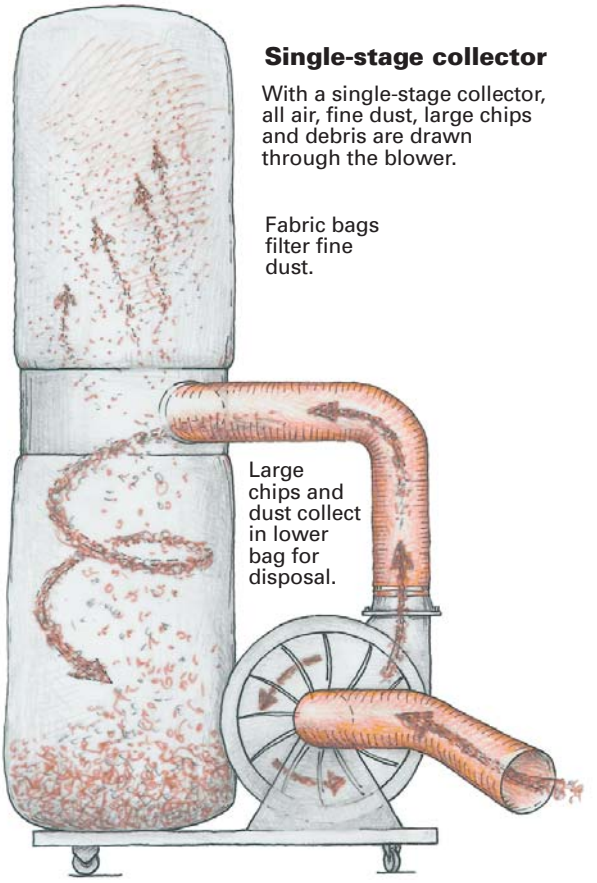
Two-stage collectors have several advantages over single-stage models. Because large debris doesn't go through the blower, there's less wear and tear on the fan and less racket caused by chunks of wood striking the blower. More important, this reduces the risk of a fire or explosion. Bits of metal, like a nail or a staple, can cause a spark when they hit the blower and ignite dust inside the filter bag. When only very fine dust is sent to the filters, they become more efficient: The filters are less likely to clog, they will need to be cleaned less often and they will allow air to flow more freely through the system.

Disadvantages? Canister-style collectors and cyclone collectors are more expensive than comparably sized single-stage units, and many two-stage systems are just too big for small shops.

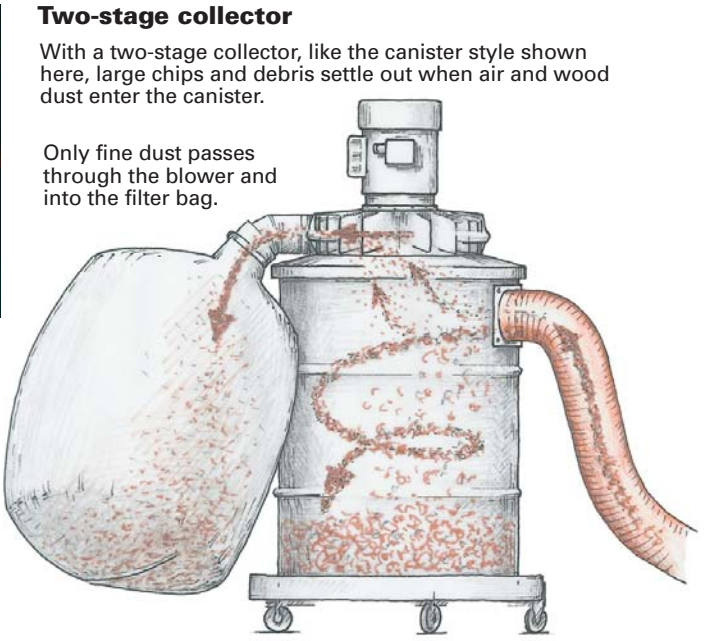
One drawback to canister-style collectors, sometimes called barrel-top collectors, is that you must lift off a heavy top assembly to empty the drum (see the bottom photo). You can make that chore easier by hooking a block and tackle to a ceiling joist over the unit to raise and lower the top.

The low cost and availability of single-stage models make them popular in many small woodworking shops. With a pre-separator added in front of the blower, a single-stage collector will perform like a two-stage unit. This conversion will increase the chip-holding capacity of the collector

***Single-stage collectors**, such as this 2-hp unit, connect easily to small central-collection systems. One drawback is that the debris enters through the unit's blower where cutoffs or stray bits of metal can cause problems.*



***The lid can be heavy** with this kind of two-stage collector. One option would be to install a block and tackle nearby with a wall cleat to tie off the rope.*



Drawings: Christopher Clapp

***A built-in cyclone** does an excellent job separating chips and dust before they reach the blower. This Delta 50-903 collector has a 5-hp motor.*

Photo: author

***A cheaper alternative—**This cast-plastic separator lid (with a 1½-hp Penn State #DC3 portable collector) fits snugly on a 30-gal. trash can. Connected to a ductwork system, the lid isolates large debris and transforms a single-stage collector into a safer two-stage unit.*

and make sawdust easier to empty. More important, it will allow you to collect larger chips and metal debris more safely.

Cyclones, separator cans and drop boxes

A cyclone is one kind of pre-separator. It's a sheet-metal cylinder with a funnel-shaped lower section that empties into a drum. Incoming air full of dust and chips swirls around until the heavier debris slows down and drops to the bottom.

You can purchase a system with a built-in cyclone, such as the Delta 50-900 series (see the photo at left). Or you can build or buy a cyclone and connect it to a single-stage system (for more on this, see *FWW* #100, pp. 76-81). Be sure the cyclone fits the air-moving capacity of your blower and ductwork system.

If you can't afford a cyclone, you can add a pre-separator to your system by installing either a dust-separator can or a drop box ahead of the blower. Though they are less efficient than a cyclone, these devices are inexpensive and can increase the chip-holding capacity of your system.

A dust-separator can is a drum or a barrel with an inlet and an outlet arranged so that heavier materials settle out as dust and debris enter it. Only fine dust travels to the blower and the filters.

You can build your own separator can by installing a few plastic plumbing fittings into the removable lid of a fiber or steel drum. Flexible hoses connect the inlet to the ductwork and the exhaust to the blower. Or you can buy a cast-plastic lid that's designed to fit over a standard 30-gal. galvanized-steel trash can (see the bottom photo). This inexpensive lid accepts 4-in.-dia. hoses and hooks up quickly to most systems. The lid is available through a number of woodworking-supply catalogs.

A drop box is an even more basic pre-separator (see the drawing on the facing page). It consists of an airtight plywood box with an inside baffle. As air from the ductwork enters on one side, chips settle and fall into a removable bin inside the box.

Choose a collector with enough power

To determine the size and power of a central collector, you'll need to know two things: the amount of air the collector's blower is capable of moving, measured in cubic feet per minute (cfm) and the amount of air resistance in the ductwork that the collector must overcome, stated as

static pressure (sp). Generally, more motor horsepower and larger blowers mean more air-moving capacity for the collection system. The amount of power you'll need depends on three factors:

1. How much sawdust your shop produces. The more debris a machine produces, the greater the volume of air needed to capture and convey it. See the chart on p. 70 for average cfm requirements for small-shop machines.

2. How far the ductwork must move sawdust. The farther or more roundabout the distance debris must travel, the stronger the collector you'll need. Ribbed, flexible hose generates more friction than straight, smooth-walled duct. Small-diameter ducts add more friction and require more power.

3. How many machines the collection system must handle simultaneously. In most ductwork systems, blast gates control the suction at each work station. Running several machines at once with two or three gates open, common in a shop with several people, requires more air and power than running a single machine with only one gate open.

If your shop is about the size of a two-car garage and you use only one machine at a time, your central collector should deliver at least 5 in. of sp and about 20%-50% more cfm than is required by your largest dust-producing machine, as shown in the chart on p. 70. Use a 4-in. pipe for most branch ducts; thickness planers need a 5-in. pipe. Connect the branches to a 5-in.- or 6-in.-dia. main duct.

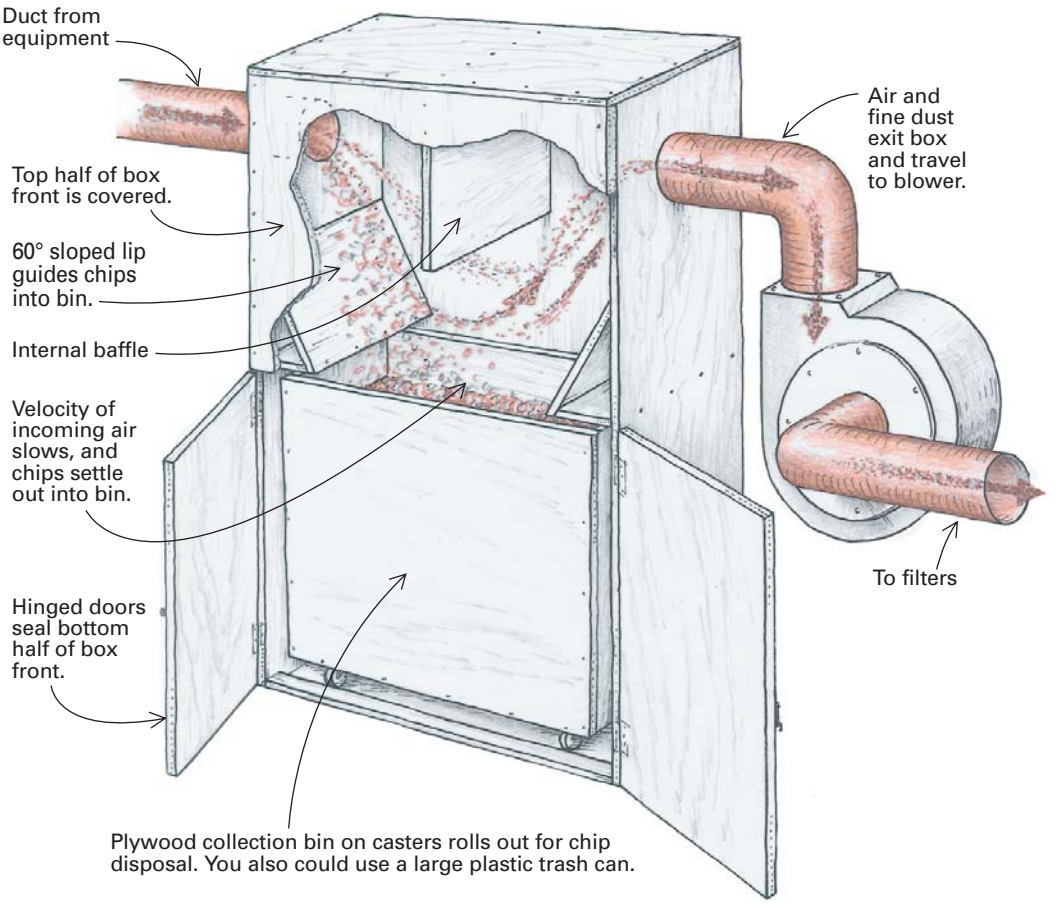
If your shop is larger or your collection system is more complicated, the only way to ensure you'll end up with the right size central collector is to design your entire system first. This involves laying out and sizing all the system's main and branch ducts, figuring the cfm needs for all the machines used at one time and calculating the air resistance, or sp losses, in the system.

This process is too complicated to cover in this article, but if you are up to doing the calculations yourself, Air Handling Systems (5 Lunar Drive, Woodbridge, CT 06525; 800-367-3828) offers a free catalog with instructions for doing the math. The company also sells a simple calculator for $10, which works like a slide rule.

If you need more help in designing your system, your local air-handling equipment supplier usually can help. Oneida Air Systems (1005 W. Fayette St., Syracuse, NY 13204; 315-476-5151) is one dealer that provides free design services.

A drop box creates a two-stage system from a single-stage collector

This 36-in. by 60-in. box, built from ¾-in. plywood, is about right for a system that moves 1,000 cfm. The size of the box is not critical, as long as you make it airtight.



Advertised vs. actual performance—Be aware that the cfm ratings you see in some advertisements reflect the amount of air a collector moves when it's not connected to any ductwork and is operating with no resistance (that's 0 sp). This is known as free-air cfm. Static-pressure ratings also can be misleading because they can represent the pressure loss generated when no air is moving at all, or at 0 cfm.

So how do you really know how much power a collector is capable of generating at a particular cfm? You can ask the manufacturer for a copy of the collector's performance curve. (The performance curve is a graph that plots the actual amount of air the collector will convey under different work loads.) If the dealer can't supply you with one, I suggest buying a unit from one who can, or select a model that is sized at least 50% larger than your requirements.

What if your collector isn't strong enough?

If you own an underpowered collector, you'll know by the telltale sawdust that accumulates around your equipment. Chips that have settled in the ductwork are another sure sign. If you can't afford to buy a new one, there are a few things that you can do to improve the efficiency of your present collector:

1. Relocate the collector so that it's closer to the machines and floor sweeps. When you reduce the length of ductwork and straighten the number of twists and turns, you lower the resistance to air flow.

2. If dust collection is inadequate at only one machine, such as the planer, move it closer to the blower. Or you could disconnect it from your main system, and use a separate dedicated collector to service just that machine.

3. Add more power by connecting two dust collectors in tandem. You'll nearly double the force of your system by attaching two units together. Run a hose from the outlet of one blower to the inlet of another. To avoid pressure imbalances, use two identical units.

4. Buy a larger dust bag, or retrofit the fan-inlet plate with a larger duct (both are

The kind of fabric matters

Cotton sateen is the least expensive and the least effective at filtering fine dust. It's also more prone to rot and mildew.

Woven polyester is more durable but not much better at capturing fine dust.

Knitted polyester stretches like the material used to make athletic tube socks. It's thick enough for good filtration. The dark lines in this bag are carbon fibers, which help dissipate static electricity.

Felted polyester has no nap (like wool felt) and tends to be more expensive than woven polyester. Its thickness creates a three-dimensional maze that traps fine dust particles better than all the other samples shown.

available from Oneida Air Systems). These methods work especially well with many single-stage collectors. Just like fitting bigger carburetors or mufflers to an auto engine, these new components help the unit convey a larger volume of air. Oneida Air Systems also sells large replacement bags.

Getting good filtration

Exhaust from the blower must pass through a filter to remove fine dust and return clean air to the shop. The quality of filtration depends on the kind of fabric material used and the filter's total surface area.

Good and better filter materials—If you purchased a single-stage collector a few years ago, it probably came with a cotton sateen or a cotton duck fabric bag. These do a poor job of filtering out dust particles smaller than 30 microns (1 micron is a millionth of a meter).

Dust particles below 10 microns do the most respiratory damage. Most of the collectors sold today come with bags sewn from polyester fabrics—they're better at filtering out harmful dust. Some manufacturers offer them as an alternative to cheaper cotton bags.

Polyester fibers can be woven, knitted or felted (see the photo above). Filter bags that are made from 12-oz. or 16-oz. felted polyester, singed on the inside by a gas flame to keep the fabric from becoming clogged, are very popular for general woodworking. They can capture 99.5% of very fine dust particles between .2 and 2 microns. For advice on which fabric is best for your collector, consult with a filter-bag company, such as Midwesco Filter Resources (400 Battaile Drive, Winchester, VA 22601; 800-336-7300).

Dust cake and filter cleaning—Fine dust builds up quickly on the inside surface of a filter, forming a film that's known as dust cake. In one way, this is good because the cake acts as a filter in its own right—the buildup of particles blocks the passage of finer and finer dust.

But as a filter becomes more clogged (industry pamphlets call this "blinded"), the air passing through the bag has more difficulty escaping. The mounting static pressure inside the bag actually reduces air flow through the entire collection system. Excess pressure will eventually force fine particles right through the fabric. To keep dust cake from getting too thick, shake the bags occasionally.

Getting enough filter surface area—No amount of cleaning will keep a filter bag working efficiently if there isn't enough surface area. An air-to-cloth ratio is the comparison of a collector's cfm rating to the total square-foot area of its filters.

For general woodworking, an air-to-cloth ratio of 10:1 is about right. So for every 10 cfm of air delivered, you will need 1 sq. ft. of filter area. Many small-shop dust collectors are skimpy on filter area. It is not uncommon to find single-stage units with air-to-cloth ratios of 35:1 or more. On many models, the lower bag also serves as a dust bin, which further reduces the effective filter area.

In addition to replacing original bags with larger ones, you can gain even more filter-surface area by building a plenum that directs exhaust from the blower to multiple filter bags, or tubes (see *FWW* #100, pp. 76-81). By using small-diameter tubes, you can add a surprising amount of filter area in a few square feet of shop space. And clean air makes a more enjoyable workplace. □

Air volume required for small-shop woodworking machines

Machine	Average cfm needed
Tablesaw (8-12 in.)	350-500
Bandsaw (up to 15 in.)	400
Radial-arm saw (10-12 in.)	400
Scroll saw	350
Jointer (up to 8 in.)	400
Planer (up to 12 in.)	500
Shaper (½-in. to ¾-in. arbor)	350-450
Lathe	450
Disc (12 in.) or belt sander (6 in.)	400

Note: These numbers are averages based on duct sizes of 4 in. or 5 in. dia. A shaper cutting a crown molding needs more air volume than the same machine trimming a ¼-in. bevel on a shelf edge. Call the manufacturer or an air-handling equipment supplier for exact figures.

Sandor Nagyszalanczy is a writer and contributing editor to Fine Woodworking *magazine. His book,* Woodshop Dust Control, *will be available from The Taunton Press this summer.*

Photo this page: author