Lessons From a Pro

Small-shop dust collection

Create a clean, healthy environment for working with wood.

By Jim Harrold
Consultants: Robert Witter and Jeff Hill

When we first work with wood, taking on a small project here and there and buying a power tool or two, addressing the mess of sawdust and chips with a broom and dustpan seems reasonable enough...and cheap. But as our passion grows and the projects become more frequent and involved, our investment in machines increases as well. And so does the sawdust. That's when we cough up the bucks for one or more portable shop vacuums to help police the area.

Eventually, we realize that our paltry militia of maintenance tools falls behind the volume of sawdust and chips. We ask: Is my shop a candidate for a central dust collection? Can I even afford such a system? And, if so, can I plan and install it myself?

Working with experts Robert Witter and Jeff Hill of Oneida Air Systems, a major player in small-shop dust collection, we'll help you answer these and other questions, and provide you with several options. By story's end, you'll know what's involved and how to proceed without getting mired in math.

Why central dust-collection makes sense

For the woodworker who fits the mold of “dedicated hobbyist,” one who spends hours every week making furniture, having dust collected at every machine means convenience and time-savings. With the right system, cleanup at the end of the day may amount to five minutes instead of half an hour or more.

In addition, according to Jeff, “a good central DC will cycle and clean air in a shop more effectively than any ceiling (air-filtration) box. It moves more air, has better filtration and pre-separation, and works with gravity to pull dust downward.” He also notes that a whole-shop system has numerous ports around the room to collect from, not just one port up high. The end result: an overall healthier shop environment and reduction of the slippery fine dust on the workshop floor.

The downside? Cost. For a one-man 20 × 30’ workshop with a standard layout of stationary machines and portable power tools, the price tag can run as high as $2,000 ($800 to $1,300 for a quality collector and the rest for fittings, pipe, and
hose). This high-end approach would include an efficient two-stage cyclone dust collector with metal pipes and fittings. However, you can work up to a whole-shop system by starting with a quality dust collector and filter and adding ductwork in stages as your budget allows and needs arise.

Says Robert, “Customers tell us that they wished they had installed a cyclone system with ducting first, instead of spending years with bags, mobile collectors, overhead units, masks, and other less effective measures.” But for the hard-charging weekend warrior, there may be a less expensive alternative.

**Opt for a portable dust collector**

If budget and space rank among your concerns, you may opt for a portable dust collector like the one shown above. At the low end, you can pick up a 1 hp unit that’s powerful enough to collect from the biggest chip-maker in your shop for around $200. Of course, it collects from one machine at a time so you’ll need to move it from tool to tool as you work through a milling sequence. Be aware, however, that many of the single-stage bag collectors pump fine micron dust back into the air while retaining the larger debris. In this case, upgrade the collector with an after-market bag or pleated cartridge with ASHRAE tested-and-rated 1-2 micron or better filter.

Or, for another $200-$300, you can get a 1 1/2 hp dust collector (the most horses you can hope to run off 110 volts). These mid-sized units can connect to two machines at the same time with dual 4” ports or one 6” port. That said, you’re best off capping or blast-gating one port and collecting from one machine at a time.

**Secondary Strategies**

Let these health-smart measures supplement your primary collection efforts:

- Wear an inexpensive dust mask or respirator when creating fine dust from sanding, turning, and similar fine dust operations.
- Ensure that every power tool has a dust port for dust/chip collection.
- If weather permits, ventilate the shop with a box-style window fan to remove fine dust.
- Use a shop vacuum for suitable portable power tools such as sanders and circular saws, and outfit it with an after-market pleated HEPA filter.
- Capture sawdust and chips with passive (gravity) boxes or bags underneath some machines such as a contractor table saw or miter saw.

**Tip Alert**

While purchasing the flexible hose to attach to your tools, also include quick-connecting adapters (Woodcraft #140259, $6.50) to speed hook-up time.
time. For superior collection in the category: spend a few more bucks and buy a two-stage portable dust collector. Says Robert, "The objective is to provide enough CFM at the machine to capture nearly all the dust and then consolidate and filter it down to the smallest particles. A portable can do this if it can pre-separate waste and capture 99% of the 1-2 micron fine (flour) dust." A portable also lets you save the cost of running ductwork throughout your shop.

When shopping for a dust collector, whether a low-dough mobile unit or a fixed model, brush up on a few terms to know what you’re buying and to assess your needs. See the “Glossary of Dust-Collection Terms” below, and then go to woodcraft.com to find a wide variety of dust collectors. Keep in mind that manufacturers’ claims regarding CFM may be grossly exaggerated. Therefore, to ensure efficiency, refrain from collecting from two tools simultaneously unless the collector is 2 hp or greater.

Finally, if you do buy a portable dust collector, implement one or more of the “Secondary Strategies” on the previous page to achieve your goals for a clean and healthy shop.

Opt for central dust collection

If you desire a full-service dust-collection system, one that pulls from every machine (though no more than one or two at a time), then let’s examine the parts that make up a system. Follow the Figure 1 anatomy drawing beginning on page 46 and ending on page 53 for an understanding of parts, pipe reductions, and installation. At the same time, see Table 2, D-C System Parts for a rundown of individual components. Note that while dust-collection pipes and fittings come in PVC, plastic, and metal, we chose metal here (and for the Woodcraft Workshop, page 24), because of the diversity of compatible parts and to avoid the static electricity found in PVC ductwork lines.

At the heart of the dust-collection system in a one-man shop is the collector itself.

Glossary of Dust-Collection Terms

D-C—Short for dust collection/dust collector.

CFM—Cubic Feet per Minute or rate of airflow. See Table 1 for the CFM required to remove sawdust and chips from a woodworking machine to a collector.

SP—Referred to as Static Pressure, this is the amount of airflow resistance in a ductwork caused by pipes, fittings, airflow reductions, direction changes, clogged filter bags, etc. Note that larger diameter pipes have greater CFM (drawing more debris) than smaller diameter pipes. The goal is to keep debris moving, and not settling in the pipe.

Single-Stage Dust Collector—A less expensive collector that pulls sawdust, chips, and other debris directly through the motor impeller before depositing it into a collection and filter bag.

Two-Stage Dust Collector—A more efficient collector that allows larger chunks, chips, and sawdust to drop into a (first-stage) collection container before reaching the motor impeller; this allows only the dust to pass through the impeller and collect in a second-stage filter bag or pleated cartridge.

Two-Stage Cyclone Dust Collector—An advanced type of mechanical debris separator, that employs centrifugal air movement to separate coarse and fine material so only ultra-fine micron dust reaches the filter. It includes a more efficient and quieter fan.
It can be either a single- or double-stage unit and consists of a blower motor (from 1hp to 3 hp), an impeller, and one or more filters (cloth bag or pleated cartridge), for containing fine dust and exhausting air. It contains a removable canister or collection bag for capturing large debris such as chips and sawdust. Depending on the amperage and horsepower, it may require a special dedicated electrical outlet. For reasons of space and noise, many woodworkers locate the dust collector outside of the shop in a garage or attached insulated shed. Doing this, however, requires you to include an air return to the shop to replace the air removed by the collector.

In a typical one-man shop, large 6"- or 7"-diameter elbows and pipe stem from the collector and tie into the main trunk line, which also may be 6" pipe. This ductwork may run perpendicularly or diagonally across the shop as shown in Figure 2, or along the walls. It may hang from the ceiling joist, attach to walls with metal straps and fasteners, or run under the workshop floor.

Branch lines stem off the main trunk line via wyes and elbows. These typically step down in pipe size (often to 5"-diameters). The branch lines may again be further reduced to 4"-diameter pipe and flexible hose, depending on the machine or tool ports they service. In some cases you may need to fashion special adapters to collect from some tools, such as a drill press. Keep in mind, however, that the more pipe length, bends, and restrictions you create, the greater the SP (airflow resistance).

**Map out a plan**

To create your whole-shop dust-collection system, map out your workshop plan on paper, locating stationary machines, power-tool stations, cabinets, workbenches, and so on. To do this quickly and accurately, use the scaled “Dream-Shop Planner” on page 64. Draw the perimeter of your shop on the grid, and then cut out the templates that reflect your tools and storage. To help you decide where to locate machines and your dust collector for maximum efficiency, keep these layout considerations in mind:

• Place the biggest chip-makers, such as your planer, jointer, and table saw, nearest to your dust collector.
• Make the main trunk line (with the largest diameter pipe) as short as possible to deliver more air volume; run it perpendicularly or diagonally across the shop. (Running it around the shop’s perimeter is the least efficient way to go.)
• Make branch lines as short as possible as well. Work to keep tools within a 30’ radius of the dust collector.
• Locate ceiling drops where vertical pipes won’t interfere with traffic flow and machining operations.
• Allow for return air for collectors installed outside the shop.
• Include clean-out locations in the system for removing clogs. (In ductwork laid out in a concrete floor, go with...
capped Y-fitting cleanouts to remove debris.)

- Avoid T fittings and sharp 90° elbows which increase static pressure (by putting two T fittings in a system you cut your airflow in half). By contrast, long-radius 90° elbows, 45° elbows, and wyes are your best choices.

- Include a floor sweep to add convenience to shop-floor cleanup.

- Terminate rigid duct lines with blast gates and reducers or adapters for hose hookups.

- Minimize each flexible hose length (from 5' to 10').

Now, locate and tape your cabinet, tool and dust collector templates on the planner grid. If placing your collector inside, avoid areas that have a gas appliance with pilot lights to prevent the risk of explosion. Regardless of whether your collector is inside or out, use remote switches to easily activate the unit from anywhere in the shop.

Next, tape down a sheet of acetate over your shop layout and draw out your duct system, including the main trunk and branch lines with the pipe widths and lengths noted and the fittings.

### Figure the D-C parts list based on your plan

With your generalized plan on acetate, tally up the specific parts you'll need. To do this, label the CFM and port sizes for each tool. To determine pipe and fitting needs, avoid messy math by adhering to the following steps regarding pipe runs no longer than 30'. This simplifies pipe and dust collector sizing for most home woodworking shops. Rely on Table 2 to assist you with fittings, and note that pipes come in metal or PVC; fittings in metal, black plastic, or PVC.

1. Use 6" pipes and fittings for the main trunk (this may be reduced from 7" at the main collector via a wye or reducer fitting). Calculate the linear pipe length and fittings needed.

2. Use 5" pipes and fittings for branch lines, reducing them as needed to accommodate the tool ports they will service. Pipes of this diameter can carry a range of 425 to 650 CFM, making them well suited for most of the tools listed in Table 1. Calculate the linear pipe lengths and fittings (connectors, elbows,
wyes, reducers, blast gates, adapters and caps) needed. If suspending the system from the ceiling, consider drop lengths as well. In any case, avoid choosing duct diameters that are too small. Try to run the largest diameter you can to the tool ports, referring to Table 1. In some cases you can increase the tool port size for better collection.

3. Figure the lengths and diameters of the flexible hose and hose clamps needed to match the tool ports.

4. Include 2”-wide aluminum tape, industrial grade silicone sealant, sheet metal screws, and metal strapping for hanging pipes.

5. Make a D-C parts list on paper for purchasing and installing.

Choosing a whole-shop dust collector

If your one-man home shop contains a variety of machines like those listed in Table 1 and the ductwork (trunk and branch lines) does not extend beyond 30’ from the collector, your options are simple. For single-tool collection (only one blast gate open at a time), consider a 1½- to 2-hp collector. For collection from two tools at a time (with all but two blast gates closed), opt for a 2- to 3-hp collector. Use any more than that and you’re indulging in overkill. If your shop is more than a one-man shop and commercial in nature, seek expert help.

Table 2: Parts for a small shop system

<table>
<thead>
<tr>
<th>COMPONENTS</th>
<th>COMMENTS</th>
</tr>
</thead>
<tbody>
<tr>
<td>*Rigid metal pipe (in 2’, 4’, 6’, and 10’ lengths)</td>
<td>1”-9” dia.; home shop needs: from 3”-7” dia.; for straight runs in a system; more expensive than PVC.</td>
</tr>
<tr>
<td>Flexible hose</td>
<td>2”, 2½”, 3”, 4”, 5”, 6”- dia.; for connecting rigid branch lines to tool ports. Secured with hose clamps.</td>
</tr>
<tr>
<td>90° large-radius elbow</td>
<td>3”-7” dia.; some adjust to fit; large-radius reduces SP when turning corners.</td>
</tr>
<tr>
<td>90° sharp-radius elbow</td>
<td></td>
</tr>
<tr>
<td>45° elbow</td>
<td>3”-7” dia.; for gentle turns.</td>
</tr>
<tr>
<td>45° Wye-Fitting</td>
<td>3”-7” dia.; preferred fitting for branch lines; offers less SP than T-fittings. Branch arms can serve as reducers.</td>
</tr>
<tr>
<td>Floor sweep (2 x 8” opening)</td>
<td>Attaches to floor and system; adds convenience to workshop cleanup.</td>
</tr>
<tr>
<td>Connectors (crimped, uncrimped)</td>
<td>2”-7” dia.; Connects pipe sections together w/screws and tape; same dia. as pipe.</td>
</tr>
<tr>
<td>Blast gate</td>
<td>3”-6” dia.; install w/screws/silicone at end of branch line; requires adapter for hose.</td>
</tr>
<tr>
<td>Blast gate/hose adapter</td>
<td>3”-6” dia.; connects flexible hose to system from tool.</td>
</tr>
<tr>
<td>Reducer</td>
<td>6” to 5”, 5” to 4”, 4” to 3”, 3” to 2” dia.; allows for stepping down to pipe, fitting, hose, or tool port.</td>
</tr>
<tr>
<td>Tool port with flange</td>
<td>3”, 4”, 5”, 6”, 7” dia.; mounted to tools for connection and for stepping up to larger port.</td>
</tr>
<tr>
<td>End cap</td>
<td>3”, 4”, 5”, 6” dia.; used to seal and terminate the end of a branch line.</td>
</tr>
</tbody>
</table>

*Schedule #40 (white) PVC pipe comes in 3”, 4”, and 6”-diameters; thinner schedule #20 (white) PVC pipe comes in 3”- and 4”-diameters only. Both come in 10’ lengths and accept a full range of plumbing fittings found at home centers and black plastic D-C fittings like those sold at Woodcraft. Costs: 4”-dia. x 10’ PVC pipe, $7.65; 4”-dia. x 6’ metal pipe, $13.29.
Install a metal D-C system step by step

With your system parts on hand, gather the tools and materials you’ll need for installation. For the metal system featured here, we used a tape measure, felt tip pen, reciprocating saw equipped with a metal cutting blade, a cordless drill, screw driver, \( \frac{1}{2} \)" sheet-metal screws, tin snips, a crimping tool, silicone caulk, a caulk gun, aluminum tape, and hose clamps. Now, solicit a helper and follow this sequence for a quality installation.

1. Assemble the dust-collector at its planned location, following instructions accompanying the unit. (We attached the motor to the cyclone barrel, and then bolted on the cyclone cone. Rather than secure the unit to the wall with a bracket, we assembled an optional iron frame for sturdy, level support, and then added the dust-bin and cartridge filter assemblies as shown in Photos A and B.)

2. Lay out the pipes and fittings on the floor in the vicinity of their installation, following your plan. Then, beginning at the dust collector, fit connectors, elbows, wyes, and pipes together as shown in Photo C to build the main trunk line.

3. Seal all joints with aluminum tape as you screw components together as shown in Photo D. A second method of sealing pipe is to use an industrial grade silicone sealant as shown in Photo E. Both measures lead to an air-tight system.

4. Build branch lines that lead to each tool, terminating them with wyes and reducers, blast gates, and hose connectors. When needed, cut pipe lengths to fit as shown in Photo F.

Tip Alert

If possible, do as much of the assembly on the floor for ease of construction.

Expert D-C layout services

If you intend to install a D-C system, note that Oneida offers a professional planning service to help you lay out and size your system, develop a parts list, and obtain installation help. This is free of charge with purchase of a 3 hp or higher system. Contact Oneida at (800) 732-4065; online: oneida-air.com.

Fortify and seal each joint with adhesive-backed aluminum tape, cutting strips long enough to circle the joint at least twice; lay down a bead of silicone along joint lines as an alternative sealing method.
measuring and marking them with a pen. Allow for overlapping of pipes and connectors at joints (usually about 1” at each end).

5 Hang the assemblies from the ceiling joists or along the wall with metal straps snipped to size and screwed in place as shown in Photo G.

6 Connect needed lengths of sized flexible hose (less is best) from branch line ports to machine ports, using hose clamps. In some cases, you may need to crimp a pipe or fitting for an inserted fit as shown in Photo H. With the installation complete, close the blast gates, activate the system, and listen for air leaks at each joint. Plug any holes with silicone.

**Tip Alert**

Improve collection efficiency on tools by replacing the factory port with a larger shop-made one. (For instance, we changed out the 4” factory port on our jointer with a 5” port made from 1/2” plywood with a 5” opening and a 5” flanged metal port.)

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**Installing a PVC system**

A Note of Caution: While we include a discussion of a PVC ductwork system in this article, we do not recommend it. And while you can find PVC ductwork systems in small shops across the country, know that NFPA / OSHA opposes using it in this application due to the potential for causing electro-static shock and fire. But if you choose this route, consider these installation pointers:

- When assembling the components of a PVC system, note that black plastic fittings, like the blast gates and reducers sold at Woodcraft, and the cream fittings all complement the system. Still, make sure you have the needed adapters so parts connect snugly. Seal joints with silicone and/or aluminum tape to prevent air leaks.
- Some metal components, purchased at a home center, may be needed to connect a PVC system to the dust collector.
- Do not glue up all of the joints. You may have to pull sections apart to deal with clogs.
- T and other tight-radius fittings and small diameter pipes will significantly reduce efficiency.
- Ground the PVC system by running braided metal wire inside the PVC piping, fittings, and flexible hoses from machines to dust collector to reduce static electricity buildup. Connect braided wires together at joints with wire nuts. (Consider Woodcraft’s Anti-Static Kit, #812502, $17.99.) Reduce the shock potential by spiral-wrapping the system with a grounded braided wire.
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