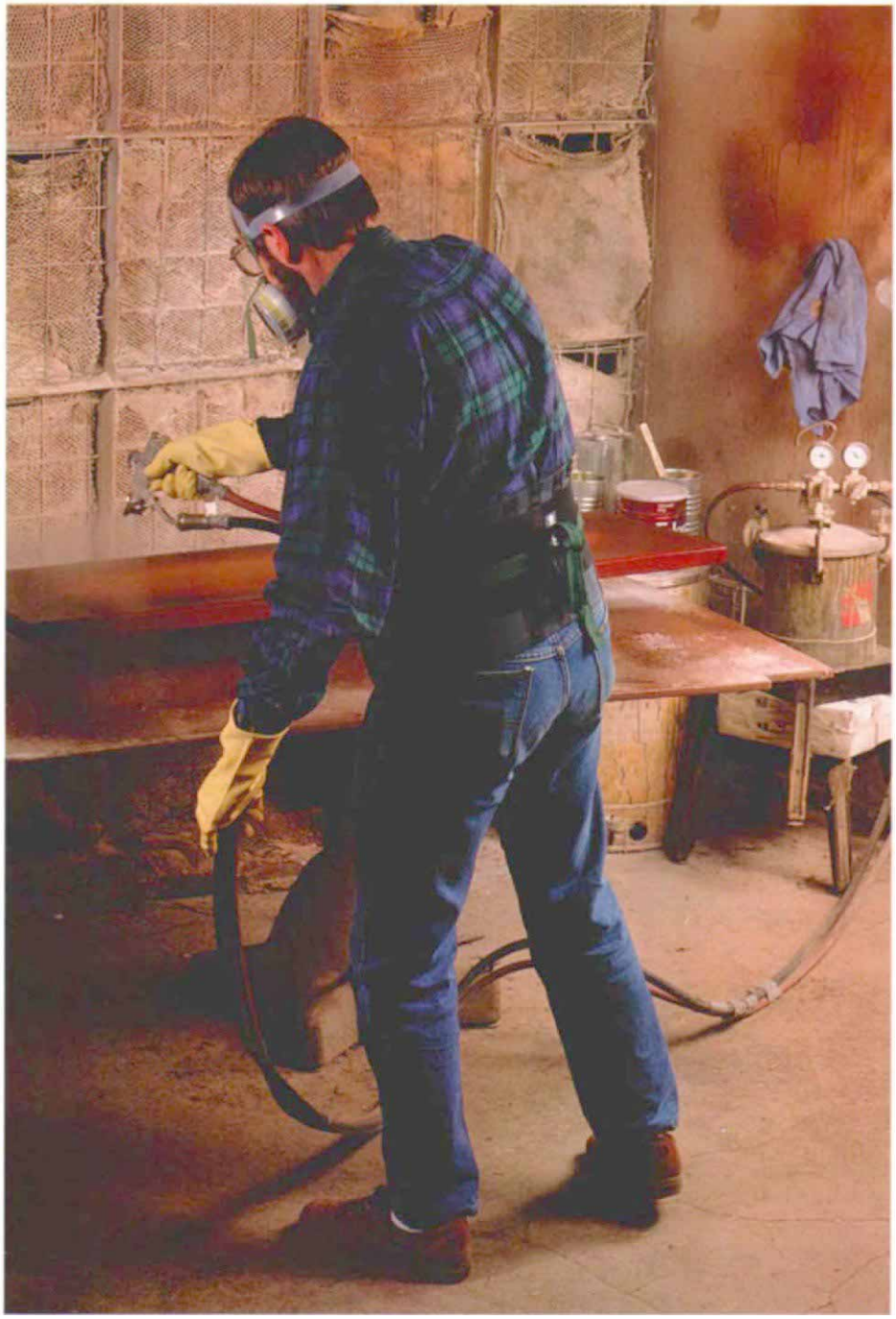


***Use a booth when spraying solvent-based finishes,*** *such as nitrocellulose lacquer. Here, the author uses a Binks high-pressure spray gun, which has a 1-gal. paint pot. These guns produce excellent results but lots of overspray.*

# Which Spray System Is Right for You?

## *What's good and not so good about four kinds of sprayers*

by Chris A. Minick

Mention the names Delta, General or Powermatic to a bunch of cabinetmakers, and everyone in the group will know you're talking about woodworking machinery. Mention DeVilbiss, Mattson or Sharpe to the same crowd, and you'll likely get some blank stares. Those companies are just three out of dozens that make spray-finishing equipment. Chances are, though, many woodworkers just don't know as much about choosing a spray system as they do about buying a tablesaw. Considering that a high-quality spray system costs as much as a decent tablesaw ($700 or more), it pays to be well-informed before you buy.

Andy Charron explains why he switched to spray finishing in his shop (see the story on p. 56 in this issue). I'll present some equipment options—high-pressure spray guns (see the photo at left), high-volume, low-pressure (HVLP) systems and airless spray guns. But first, it would be helpful to know a little about spray-gun anatomy.

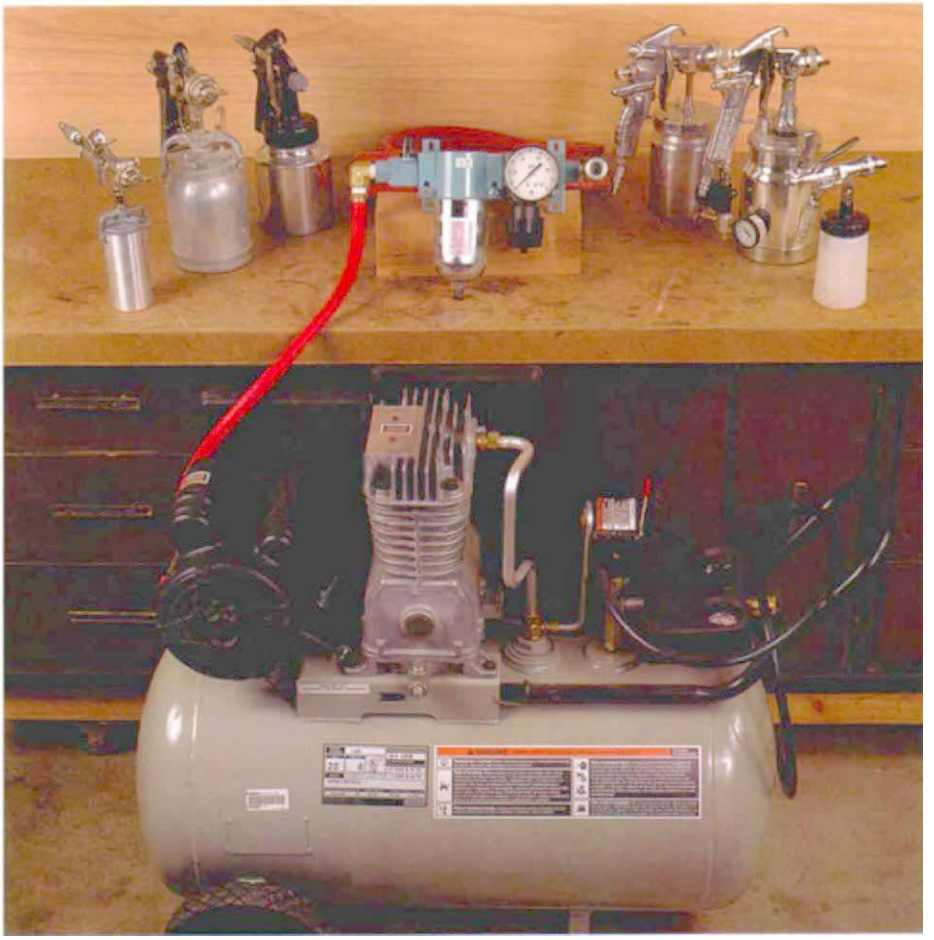
### How a spray gun works

The basic principle behind a spray gun is relatively straightforward. A stream of liquid finish is forced into an airstream, which breaks the liquid into tiny droplets (atomization) and carries them to the target surface. It sounds simple, but in reality, a collection of precision parts must work in concert to pull the whole thing off.

In a standard high-pressure system, air flows from the compressor hose through a series of valves and baffles in the body of the gun and out through an air cap. The valves and baffles control the maximum atomization pressure at the air cap. The volume of air used by the gun as well as the spray pattern is governed by the size and placement of the holes in the air cap (see the drawing on p. 60).

A standard air cap for furniture finishing

Photos: Alec Waters



***An air compressor can power a high-pressure or conversion-air HVLP spray system.*** *With either type, you'll need an oil and water filter separator, a regulator, an air hose and couplers. Choices for guns (from left): conventional touch-up, external and internal mix, two HVLP units and conversion-air touch-up.*

produces a tapered (fan) pattern 9 to 11 in. long. Typically, the gun uses about 8 cubic feet per minute (cfm) of air at 50 psi.

Pulling the trigger extracts the needle from the fluid tip, which opens the orifice and allows the finish to enter the airstream. The size of the orifice and the viscosity of the finish control the amount of material sprayed. I've found that a 1mm orifice is ideal for finishing furniture. The fluid tips and needles are sold in matched sets (fluid setups). Most spray-system manufacturers have technical-service departments that will help you choose the right one.

Once the finish exits the tip, high-pressure air from the air cap blasts the stream into tiny droplets. The droplets can range from about 15 microns in dia. to 70 microns or more. The size depends on the fluid viscosity and on the equipment. Once the atomized finish is deposited, it flows together to form a smooth film. Generally, the smaller the droplets, the better the finish.

***Gun composition affects the kind of finishes you can spray***—A gun that has an aluminum cup and fluid passages is compatible with hydrocarbon-solvent-based finishes like nitrocellulose lacquer and oil-based varnish. But within a matter of hours, the same gun will be corroded beyond repair if it is used to apply a finish that contains a chlorinated solvent, such as methylene chloride (which is the main ingredient in many paint strippers). Even nonflammable solvent cleaner will corrode aluminum parts. Similarly, the alkaline portion of waterborne finishes can damage bare aluminum parts if the gun is not cleaned immediately after use.

As a corrosion-fighting alternative to aluminum, some low-cost units combine plastic cups and dip tubes with brass fluid-handling parts. But brass wears quickly,

***Turbine-driven HVLP systems are compact,*** *but the hoses are cumbersome. Both the two-stage Graco/Croix unit (left) and the Wagner single-stage model spray efficiently and are portable.*

***Airless spray systems work well with latex paint*** *and most varnishes, but they don't apply other finishes well. If not the right viscosity, the finish will be poorly atomized and leave a coarse, blotchy surface.*

particularly if the gun is used to spray pigmented finishes like paint. The pigments act like the abrasives used in sandblasters.

Mild-steel components (especially fluid tips and needles) are also common in inexpensive spray guns. Though steel is compatible with most finishes, it has a nasty tendency to rust. One solution is to buy a gun that has a stainless-steel cup and fluid-handling parts, but that type is pricey. Those guns make sense for industrial users, but they are overkill for small shops. As an alternative, some spray guns come with stainless-steel fluid passages and a Teflon-lined aluminum cup. The Teflon lining protects the cup from corrosion and makes for easy cleanup.

## High-pressure spray equipment

Early in this century, high-pressure spray equipment was developed in response to the automotive industry's need for high-speed finishing. Spray components have changed little since that time (see the top photo on p. 59). A full system consists of three main parts: a compressor (with attendant hoses, tank and pressure regulator), an oil and water separation device, and a spray gun.

The air compressor is the heart of the spray system; both the horsepower rating and tank size affect spray performance. A 3-hp compressor with an air output of 10 cfm and a 20-gal. air tank is really the minimum size.

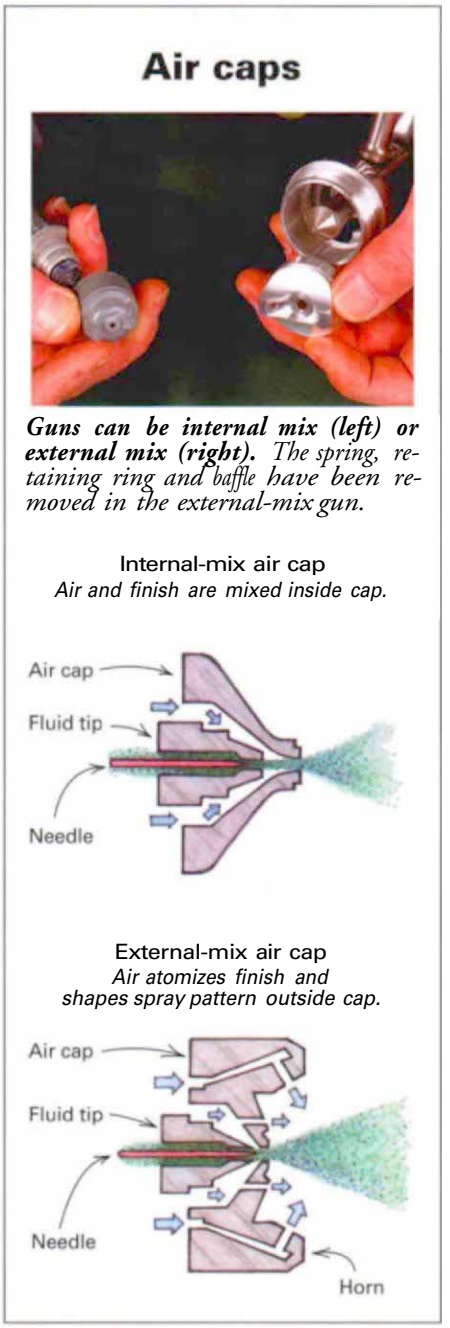
When air is compressed, water vapor in the air condenses to a liquid. If not removed, the water that passes through the spray gun will cause all kinds of finishing problems. So an oil and water separator is a critical part of any compressor-driven spray system. The separator also removes residual oil that's used for lubrication of the compressor.

***Internal mix or external mix***—High-pressure spray guns are available in two types: internal and external mix (see the photo and drawings at right). The mix designation is based on where the airstream is introduced into the fluid stream.

Most internal-mix guns (air and fluid are mixed inside the air cap) produce a coarsely atomized spray. Although this spray is unsuitable for applying lacquers or other fast-drying finishes, it is ideal for applying thick, difficult-to-spray materials, like adhesives and pore fillers. Internal-mix guns consume modest amounts of air and can be powered with a 1-hp or 2-hp compressor. But they are limited to spraying slow-drying varnishes and paints.

By contrast, external-mix guns (air and fluid are mixed outside the air cap) are versatile. They're the most common spray guns used in woodworking shops. Hundreds of fluid tip/needle/air-cap combinations are available to allow the spraying of virtually any liquid at almost any pressure. External-mix guns can be fed from a 1-quart siphon cup attached to the gun or pumped from a 1-gal. remote pressure pot when greater quantities are needed.

External-mix spray guns have two drawbacks. They use lots of air, so they require at least a 3-hp (4 hp or 5 hp is preferable) compressor. And they aren't very efficient at putting the finish on the work. Only about 35% of the finish actually lands on the target; the rest ends up as overspray. High-pressure spray guns only make sense in a shop that has a good spray booth.




## More finish ends up on your project with HVLP

High-volume, low-pressure (HVLP) spray equipment has been around a while. In the late 1950s, I painted models and birdhouses with an HVLP painting attachment that came with my mother's canister vacuum cleaner. HVLP equipment is more sophisticated now, but the underlying concept remains unchanged. To atomize the finish, HVLP systems use high volumes of air rather than high pressure. Unlike conventional spray guns, HVLP guns produce a soft spray pattern. The benefits are increased transfer efficiency, low overspray and almost no bounce-back. Simply put, HVLP spray guns put more finish on the project and less on everything else in the shop and in the environment.

Spray-equipment manufacturers have taken two very different approaches to HVLP. Some have developed turbine-driven systems and others have developed conversion-air HVLP systems, which are driven by a standard air compressor.

***Turbine-driven HVLP spray systems are portable***—Turbine HVLP systems use a fan (like those used in vacuum cleaners) to generate from 45 cfm to 110 cfm of air at pressures between 2 psi and 7 psi. You can buy turbines in three power levels: one, two or three stage. The center photo on p. 59 shows a two-stage turbine and a single-stage unit. Each stage, or fan section, in the turbine adds approximately 40 cfm and 2 psi of air output.

Unlike a compressor, a turbine blows out a continuous stream of warm, dry air at a constant pressure. This eliminates the need for pressure regulators and air dryers (separators). But warm air can be a problem. The metal handles of some spray guns can get uncomfortably hot.

Also, dried drops of finish tend to accumulate on the fluid tip; eventually, the finish glob breaks free and deposits itself on the freshly sprayed surface. On the positive side, turbine systems are compact, store easily and operate on 110v current.

The more stages a turbine has, the wider the viscosity range of the spray finish. When I sprayed with a one-stage turbine (a Wagner Finecoater), I had to thin the finish to get proper atomization. Thinning is the kiss of death for some waterborne finishes. When I sprayed the same finish with a two-stage turbine (a Graco/Croix CX-7) there was sufficient power to spray without thinning. I didn't try a three-stage tur-

Drawing: Christopher Clapp

bine. Designed for multiple guns and high production, they're a bit pricey for me (more than $1,000).

***Conversion-air HVLP spray systems are versatile—***Conversion-air HVLP systems convert compressed air (under high pressure) to a high volume of air (at low pressure) by passing it through baffles and expansion chambers in the gun body. A decent gun costs $250 or more. Conversion-air guns have the reputation of being air hogs. But the latest conversion-air spray guns will operate off most 3- or 4-hp compressors. If your shop already has a compressor, it may power a conversion-air HVLP gun.

A big advantage that conversion-air systems have over turbines is that the atomization pressure at the air cap can be adjusted (between 2 and 10 psi with most guns) to accommodate a wide range of coating viscosities. I compared the two types of HVLP systems side by side (see the box below). The conversion-air system consistently produced a finer atomized finish, a higher delivery rate and a noticeable decrease in overspray.

Conversion-air spray guns work best when connected to ⅜-in. air hoses. The quick-connect fittings on the hose and the spray gun must be matched (connectors are available at most auto-paint and compressor repair shops). Use a ⅜-in. coupler; a ¼-in. coupler will negate the advantage of the larger hose.

*Considering that a high-quality spray system costs as much as a decent tablesaw, it pays to be well-informed before you buy.*

## Airless spray systems

Airless systems usually are associated with house painting rather than furniture finishing. But airless spray systems are common in large furniture factories. These commercial units operate at pressures approaching 4,000 psi. However, high pressure, high delivery and high efficiency come with a high price tag—upward of $1,500 for an entry-level unit.

Consumer-sized airless units (see the bottom photo on p. 59) still have a place in the shop. I like them for applying latex paint and oil-based varnish on certain projects. The motor size of an airless gun determines its price and its versatility. A 110-watt gun is powerful enough to spray unthinned latex paint. But with a 45-watt unit, the paint has to be thinned significantly. A motor rating of 85 watts or more usually is adequate for spraying furniture.

Unfortunately, airless spray guns produce a coarse spray pattern. So only slow-drying paints and varnishes should be applied with them. Lacquers, including waterborne varieties, tend to dry before the droplets flow together. The result is a rough texture (orange peel).

Even with these limitations, however, an airless spray system can help get you started spray finishing—and for a reasonable price (around $200). One of the best things about an airless spray unit is that it doesn't use a cumbersome air hose. It just needs an extension cord.

## The choice is yours

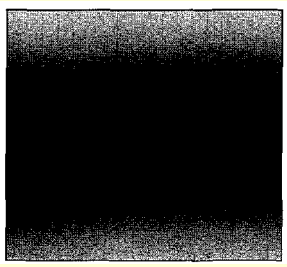
If you're considering a spray system for your shop, take a good, hard look at conversion-air HVLP spray systems. As a bonus, you'll have an air compressor to do other things in the shop. □

*Chris Minick is a finishing chemist and woodworker in Stillwater, Minn. He is a contributing editor to* Fine Woodworking.

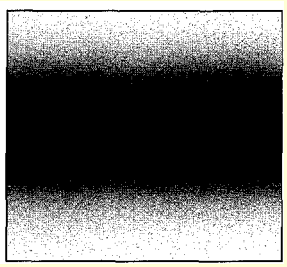
# *Evaluating spray patterns*

I couldn't resist comparing the performance of the spray systems in this article. I used a gloss, water-based lacquer (tinted black) in each spray gun. This is a demanding test when you consider I didn't adjust the viscosity. Spray patterns reveal where atomization was poor (large spots on borders) and where fan adjustments were limited (wide dispersion band). In general, high-pressure and conversion-air HVLP systems delivered fine atomization and more uniform spray patterns. Turbine HVLP and airless systems produced coarser spray patterns. *—C.M.*

**Fine and uniform**

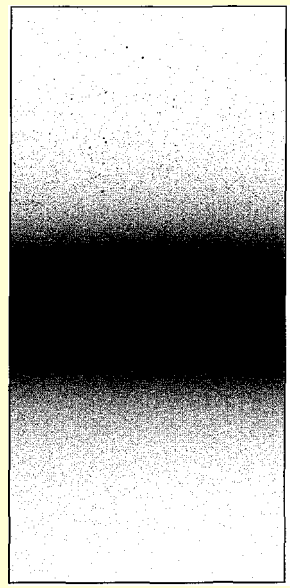


***Conventional high-pressure spray*** *(from CalHank touch-up gun).*

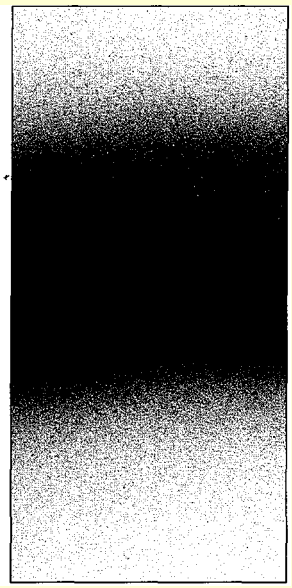


***Conversion-air HVLP spray*** *(from DeVilbiss touch-up gun).*

**Coarse and splotchy**



***Turbine HVLP spray*** *(from Graco/Croix gun). Finish was thicker than recommended viscosity.*



***Airless spray*** *(from Wagner gun). Finish was thinner than recommended viscosity.*