Turbine HVLP Sprayers

(high-volume low-pressure)

We take a look at several units that sell for under $500

BY CHRIS A. MINICK

My mother bought a new vacuum cleaner about 40 years ago. Packed in the box with the accessories was a crude, plastic spray-gun attachment. The gun attached to one end of the vacuum-cleaner hose that was also mounted to the blower of the vacuum-cleaner motor. One afternoon when Mom was out of the house, I dragged her new vacuum cleaner to the basement and spray painted several of my model airplanes. I didn't know it at the time, but this was my first experience with high-volume low-pressure (HVLP) spray equipment.

HVLP technology may have remained that simple had it not been for the South Coast Air Quality Management District (SCAQMD) in Los Angeles. For decades, high-pressure, compressor-driven spray equipment was the only game on the block. The equipment is extremely versatile, spraying anything from water-thin liquids to molasses-thick paste. However, this versatility comes at a price: The spray gun must be tethered to a large, high-output, high-pressure compressor. Also, the transfer efficiency—a measure of how well the gun delivers the finish—of these spray guns is notoriously bad.

In the early 1980s, SCAQMD and other air-quality agencies across the country enacted stringent regulations that require spray guns to have transfer efficiencies of 65% or higher, running at air pressures of 10 psi or less. High transfer efficiency and low overspray translate into more coating on the project and less in the air—better for the sprayer operator and the environment.

Compact, self-contained and portable

Unlike conventional high-pressure spray guns that hook up to large-volume compressors and are sold separately, HVLP sprayers are sold as complete units consisting of a gun, a turbine and an air hose.

HVLP turbines are smaller than most compressors. This unit weighs less than 13 lbs. and is less than 12 in. high.

The limiting factor for HVLP systems is the amount of atomization pressure at the tip of the gun. A gun with only 2.8 psi, for example, cannot spray undiluted conversion varnish.

TURBINE POWERED

HVLP sprayers are driven by high-speed compression fans that rotate at about 20,000 rpm. Each fan is called a "stage." In general, the more stages, the more varieties and thicknesses of finish the unit can spray.

Photos, except where noted: Michael Pekovich; this page (top): William Duckworth

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WHAT TO LOOK FOR BEFORE YOU BUY

Most stores will let you check out an HVLP sprayer before you plunk down your cash. Here are six things to look for:

1 Check the atomization pressure at the spray gun's tip with an inexpensive pressure gauge: 2 psi is the minimum required to spray most finishes successfully.

2 With the turbine running and gun attached, check air-hose flexibility. You should be able to maneuver the gun into tight spaces without straining your arm and without the hose getting in the way.

3 Measure the air temperature at the end of the hose with the gun detached. Temperatures higher than 120°F tend to clog the nozzle and air cap, especially with water-based finishes.

4 Inspect the spray-gun air cap. It should have clean air holes and a smooth surface.

5 Smell the air exiting the gun. Vapors from the plasticizers used in the manufacturing of the air hose may be irritating.

6 Inspect the spray-gun cup for corrosion; don't buy a corroded cup.

To comply with the new regulations, companies developed two distinctly different spray-gun systems. Manufacturers of high-pressure sprayers, such as Binks and DeVilbiss, modified their basic high-pressure guns, creating one that converts high-pressure, compressor-supplied air to low-pressure (10 psi or less) air at the air cap. This type of gun, for obvious reasons, is known as a conversion HVLP spray gun. The original conversion guns met all regulatory requirements, but they were tremendous air hogs. Consuming air at a rate of 20 cu. ft. per minute (cfm) or higher, just one spray gun required a 10-hp compressor. Large shops could accommodate conversion guns, but small, custom shops did not have the air power to run them.

To answer that market need, the turbine HVLP spray gun was born. In this system a small, high-output blower (the turbine) supplies a high volume of low-pressure warm air through a fairly large-diameter hose. Each component—turbine, hose and spray gun—plays a critical role in the overall performance, which is why turbine HVLP sprayers are sold as a complete system rather than as individual components. These compact, self-contained, portable spray systems are increasingly popular with wood workers, especially as the prices continue to drop. I looked at five HVLP turbine systems that sell for under $500. Here I'll share the results of my tests and give you some tips on selecting a system that will work for you.

This sprayer runs on hot air, too. *Since 1938, some vacuums have come with a spray-gun attachment.*

Turbines drive the air supply

Turbine, in HVLP vernacular, is a fancy term for a vacuum-cleaner motor. Motors manufactured by the Ametek Lamb Electric

TURBINE HVLP SPRAYERS

American Turbine AT 950

PRICE: $495

Pros

The AT 950 is the most compact, portable system of those tested. The gun is made of metal, and the system has an air-reducing valve to regulate atomization pressure.

Con

The air hose is slightly stiff.

Campbell Hausfeld HV 3000

PRICE: $399

Pros

The HV 3000 has a convenient built-in hose-storage rack on the turbine, and an interchangeable fluid nozzle and fluid needle are supplied. The system also has an air-reducing valve to regulate atomization pressure.

Cons

The air hose on the HV 3000 is located at the top of the gun, making the unit awkward to use. The trigger is located too far forward for comfortable use, and a squared-off grip adds to the discomfort. The air hose spews a high concentration of plasticizer vapors during use. The air cap causes an irregular spray pattern, and the gun produces a large volume of overspray. Overall, the unit has poor transfer efficiency. The spray-gun cup of the unit tested was corroded out of the package.

Lemmer T-55

PRICE: $375

Pros

The T-55 is an extremely comfortable sprayer to use, and it comes with a well-written, informative instruction manual. Of the units tested, the T-55 has the best turbine filtration. The sprayer comes with a viscosity drip cup and is equipped with a 14-ft. power cord.

Cons

The T-55 has a slightly stiff air hose and no air-reducing valve.

Apollo 700

PRICE: $499

Pros

The 700 is the most comfortable sprayer to use. It has an extremely flexible air hose, filters are easy to replace, and the plastic handle stays cool during use.

Cons

On the downside, the 700 has no air-reducing valve to regulate atomization pressure, and it produces a spray pattern that's not elliptical (left). Also, I found the manual to be poorly written.

Wagner 2600

PRICE: $499

Pros

The 2600 is a well-balanced sprayer with an industrial-quality, nonbleeder gun. The sprayer has a flexible rubber air hose, which makes the unit easy to maneuver. The system has an air-reducing valve to regulate atomization pressure and achieves very fine atomization. The 2600 had the least amount of overspray in the test (left). For convenience, the spray gun is stored in the turbine housing.

Con

The only problem with the 2600 is that it has small turbine filters.

MODEL	APOLLO 700	LEMMER T-55	CAMPBELL HAUSFELD HV 3000	WAGNER 2600	AMERICAN TURBINE AT 950
TURBINE INFO					
Amps	10	8	12.5	11	8
Stages	2	2	3	3	2
Diameter	5.7 in.	5.7 in.	5.7 in.	5.7 in.	5.7 in.
AIR OUTPUT					
Per manufacturer	112 cfm	55 cfm	65 cfm	80 cfm	52 cfm
Measured at hose	23 cfm	25 cfm	38 cfm	40 cfm	31 cfm
Measured at gun	11 cfm	15 cfm	13 cfm	15 cfm	13 cfm
AIR PRESSURE					
Per manufacturer	4.5 psi	3.9 psi	6 psi	6 psi	4.25 psi
Maximum	3.75 psi	3.5 psi	5.25 psi	5.75 psi	3.5 psi
Atomization	2.8 psi	2.5 psi	4.25 psi	4 psi	2.8 psi
TEMPERATURE					
Measured at hose	134°F	104°F	126°F	112°F	99°F
Measured at gun air cap	114°F	88°F	115°F	84°F	85°F
SPRAY GUN INFO					
Type	Bleeder	Bleeder	Bleeder	Nonbleeder	Bleeder
Hose connection	Handle	Handle	Top	Handle	Handle
Fluid nozzle orifice size	1mm	1.4mm	General purpose	1.3mm	1mm
Gun body (material)	Aluminum	Aluminum	Plastic	Aluminum	Aluminum
Gun cup (material)	Aluminum/ Teflon	Aluminum	Aluminum	Aluminum	Aluminum
Air-reducing valve	No	No	Yes	Yes	Yes
Transfer efficiency	60%	65%	50%	67%	69%
Overspray	17%	14%	34%	11%	16%
Atomization	Fine	Fine	Coarse	Very fine	Fine

AIR OUTPUT

Measurements of actual air output, made with an anemometer, did not agree with those of most of the manufacturers.

AIR PRESSURE

The air pressure at the spray-gun tip is what counts. A small difference in this atomization pressure can make a big difference in how well these systems work, especially with some water-based finishes.

TEMPERATURE

Turbine systems throw out a lot of hot air. Some manufacturers assert that the warm air generated by the turbines causes the finish to flow out more smoothly—a claim the author disputes.

Co. propel the majority of HVLP systems produced in North America. The motors drive small, high-speed compression fans. Turbines are rated by the number of fans—called stages—attached to the central motor shaft. Single-stage turbines have one fan, two-stage turbines have two fans, etc. More stages translate to higher airflow and higher air pressure at the spray gun. You might reason that the airflow figures would be a good way to compare turbine power of different HVLP systems, but this is not necessarily true. I found the air-output ratings in the manufacturers' literature to be practically useless for comparison purposes. For example, the air output for the Apollo 700, a two-stage unit, is rated at 112 cfm while the output for the Lemmer T-55, another two-stage unit, is rated at 55 cfm. According to the Ametek Lamb data sheets, the outputs should be almost identical.

I talked with an airflow engineer to find out how to determine accurate airflow values. Following his advice, I constructed a test chamber with a 6-ft. section of 6-in.-dia. heating duct and ran my own airflow tests. I borrowed a hot-wire anemometer—a device used to measure airflow—to measure the air output of each HVLP turbine at the end of the air hose and at the air cap of

Photos, this page: William Duckworth

the spray gun. The results startled me. According to my measurements, Apollo's air-output values dropped 80%, to 23 cfm, when measured at the end of the hose and to 11 cfm when measured at the spray gun. However, the Apollo unit was not alone. I concluded that all of the manufacturers in this test dramatically overstated the air output of their respective turbines (see the chart on p. 65). Clearly, air-output numbers published in the manufacturers' literature are of little value to the consumer. But fortunately, airflow figures don't mean as much as the atomization pressure, which is the real key to successful spray finishing.

Atomization pressure at the spray gun is the best measurement to use to compare turbine HVLP spray systems. Best of all, you can check it in the store before you lay your cash on the line. All you need is an accurate pressure gauge that will measure from 0 psi to 10 psi.

I purchased a fuel-pump gauge at an auto-parts store for $15 and used it to measure the air pressure at the end of the supply hose and the atomization pressure at the air cap on the spray gun. Once again, I found little correlation between my measured pressures and the manufacturers' published atomization pressures. On average, my figures were about a third less than those claimed by each manufacturer. The notable exception was Lemmer, which actually understated the atomization pressure on its model T-55 gun by about a third. The difference between 4.25 psi and 2.8 psi may not sound like much, but it makes a big difference in gun performance. To put these numbers in perspective, at 4 psi you can spray an undiluted conversion varnish; at 2.8 psi you cannot.

The fans in a typical HVLP turbine rotate at about 20,000 rpm. That much speed generates a lot of heat, warming the air supply to the gun. As far as I can tell, warm air is more of a nuisance than a benefit. Some manufacturers claim that the heat helps the finish flow out better, but I doubt the finish is in the airstream long enough to warm up appreciably. However, the warm air does heat up the air cap and the fluid nozzle, drying out and eventually clogging the gun with any overspray that may land on those parts. This is not a serious spraying problem; it's just a cleanup problem, especially on the units that generate higher temperatures. Still, if all else were even, I'd purchase the cooler outfit. After 10 minutes of operation, I measured the temperature with a dial thermometer.

Hoses should be flexible

Crush resistance and flexibility are two things I look for in an air-supply hose of an HVLP system. Invariably, you will step on the hose while spraying, and a crushed hose will cut off the air supply at the gun. All units passed my crush test with flying colors. Hose flexibility is another matter.

A stiff hose makes the spray gun difficult to maneuver, which may result in a poor spray job. Apollo attaches a short length of highly flexible hose between the gun and the air-supply hose. This arrangement provided the best maneuverability and made it the most comfortable sprayer to handle. The Wagner unit is equipped with a heavy-duty rubber hose that provided nearly the same flexibility. The hoses of the other three sprayers felt a bit stiff by comparison.

Except for Wagner, all of the manufacturers provide plasticized vinyl air hoses with their sprayers. Vinyl hoses tend to stiffen as they age—especially at the elevated operating temperatures of these sprayers—because the vinyl emits the plasticizers that make it flexible. During normal operation, all of the vinyl hoses gave off an irritating smell. The concentration of plasticizer vapors spewing from the Campbell Hausfeld

A spray test of three finishes

I sprayed almost 6 gal. of finish (polyurethane varnish, nitrocellulose lacquer and a spray-grade water-based finish) with the five HVLP systems I looked at. None of the units had trouble spraying any of the finishes. However, some systems performed better than others.

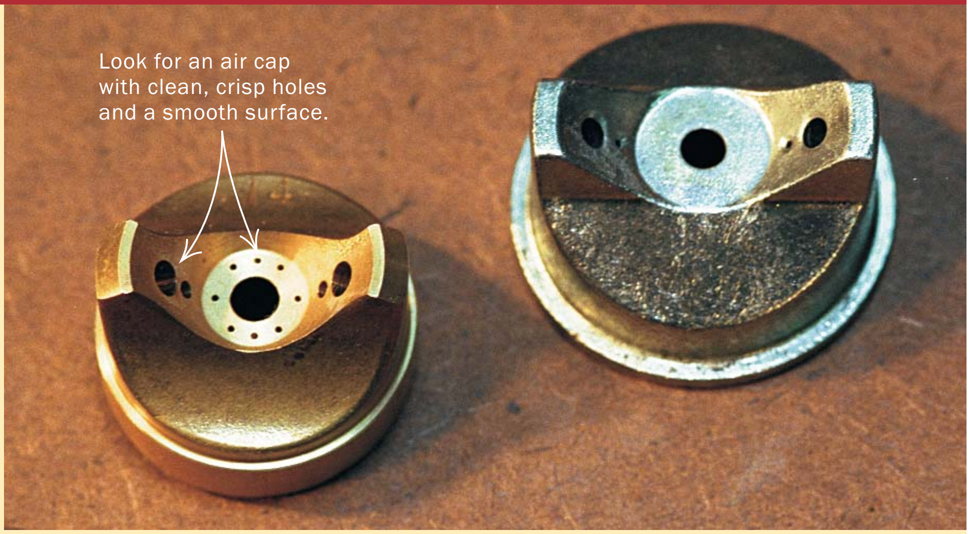
I was particularly impressed with the low overspray and fine atomization pressure of the Wagner 2600. The American Turbine AT 950 and Lemmer T-55 were close second choices. I had trouble adjusting the needle-packing gland on the Apollo 700 spray gun, and I never did get it adjusted to my complete satisfaction. Either the packing was too tight, which prevented the needle from stopping the fluid flow, or it was too loose, and finish dripped onto my hand. The Campbell Hausfeld HV 3000 produced a coarse spray that left noticeable orange peel on the sprayed surface. It also left heavy stripes in the finish because of a poor air-cap design.

Unfortunately, the HVLP sprayer industry does not adhere to any standard test methods for evaluating spray-gun performance. Each manufacturer develops its own spray tests, which makes it difficult to compare systems based on manufacturers' claims. To determine how well these systems lived up to the claim of high transfer efficiency and low overspray, I conducted a series of quasiscientific tests in my shop.

High transfer efficiency and low overspray are the hallmarks of HVLP sprayers. I've seen claims of 90% transfer efficiency for some industrial sprayers. It may be possible to achieve 90% transfer efficiency if you spray only the center of a large, flat panel, but few of us rarely have to do only that—we finish three-dimensional furniture.

For my tests I built three plywood boxes, 24 in. long by 12 in. wide by 10 in. high, to simulate a piece of furniture. By weighing the spray gun and the boxes before and after each test, I was able to calculate the transfer efficiency. I tested each HVLP unit three times, then I averaged the results to arrive at the transfer efficiency shown in the chart on p. 65. To keep things fair, I sprayed the same finish with each gun after adjusting each one to produce a 6-in. spray pattern. I was surprised at the high transfer efficiency achieved by all of the units I tested. A 69% transfer efficiency is great in anybody's book.

Overspray and atomization are more subjective measures. Overspray means different things to different finishers. To me, overspray is that small amount of finish that falls back onto the sprayed surface, giving a rough tex-



Which air cap delivers a better finish? *A well-machined air cap, such as the Lemmer (left), had a more efficient spray pattern with less overspray than the Campbell Hausfeld cap (right).*

ture to the finished piece. To evaluate this elusive but important parameter, I placed a grid over the test spray pattern and simply compared the number of squares inside the central spray pattern to the total number of squares with finish in them. Simple division yielded a percentage. Although this test may not be absolutely accurate, the overspray values I calculated reflect what I observed in my spray booth. Overspray of 20% or less is acceptable in most cases. Atomization is a purely arbitrary value based on my spraying experience with high-pressure and other HVLP systems. Very fine atomization is similar to that of a high–pressure gun; coarse atomization is not suitable for furniture finishing.

To compare the test sprayers with standard high-pressure equipment, I conducted the same series of tests with my Binks model 95 high-pressure spray gun. My trusty Binks was the hands-down winner of the atomization contest, but it exhibited a miserable 42% transfer efficiency and an immeasurably high overspray.

The air cap has a major influence on transfer efficiency, overspray and overall performance of any spray gun. A good-quality air cap will have clean, crisp holes in the air horns and a smooth surface without any bumps (see the photo above).

unit during my air-output tests was high enough to make my eyes water and my breathing difficult. I had to turn on a ventilation fan and leave the shop. By contrast, the rubber hose on the Wagner gave off no detectable smell.

Low-pressure guns work differently

Turbine-driven HVLP spray guns and conventional high-pressure spray guns look the same, but the insides are entirely different. The large air passages inside an HVLP gun make it beefier than a conventional spray gun. (I prefer the added bulk, because it fits my hand better.) But that's not the only difference between the two designs. The HVLP guns lack the fan-pattern adjustment knob commonly found on high-pressure spray guns. Instead, the fan pattern of an HVLP gun is adjusted by moving the air cap in or out, relative to the fluid nozzle. Unlike high-pressure guns, most HVLP guns are bleeder-type guns. Air flows (or bleeds) through the gun continuously, even when you're not spraying the finish. For that reason, I find bleeder guns bothersome. The constant flow of air stirs up dust in my shop, and the noise is annoying. Nonbleeder, turbine-driven HVLP guns, in which all airflow stops when you release the trigger, are usually found only on high-priced industrial spray systems. But to my surprise, the Wagner 2600 system comes with an industrial-quality, nonbleeder gun as standard equipment.

A basic tenet of spray finishing is that thinner finishes require less atomization pressure than thicker finishes. By keeping the pressure set to the minimum required to atomize a finish, you can greatly improve transfer efficiency and decrease the amount of overspray. To adjust atomization pressure on a compressor-driven sprayer, simply adjust the regulator. But turbine-driven HVLP systems don't have a pressure regulator. American Turbine, Campbell Hausfeld and Wagner have solved that problem by building an air-reducing valve into their spray guns. Slightly closing the valve to reduce atomization pressure at the spray tip improves the performance of these guns, especially when you want to spray thin finishes.

How does it feel?

Not surprisingly, the handle design and air-hose placement affect the ease with which a spray gun is used. Simply put, the better it feels in the hand, the easier it is to use. The air hose connects at the bottom of the handle and hangs down toward the floor on the American Turbine, Apollo, Lemmer and Wagner guns. This arrangement keeps the hose out of the way and allows maximum maneuverability. The air hose on the Campbell Hausfeld connects at the top of the gun and points backward over the operator's arm. I found that design awkward to use, and it would clearly make spraying inside cabinet carcases especially difficult.

The handle design of the Lemmer T-55 made this gun feel like an extension of my arm. The trigger was comfortable and positioned perfectly, and the grip rested nicely in the palm of my hand. The Campbell Hausfeld gun was the opposite. It had an uncomfortable, squared-off grip, and the trigger was too far forward and dug into my finger. My hand hurt after spraying with the Campbell Hausfeld gun for an hour or so. Worse yet, when I first unpacked the gun, the inside of the aluminum cup was severely corroded and contained some unknown brown liquid. I checked two other Campbell Hausfeld HV 3000 sprayers at two different stores, locally, and found the same conditions on both. □

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Photo, this page: William Duckworth