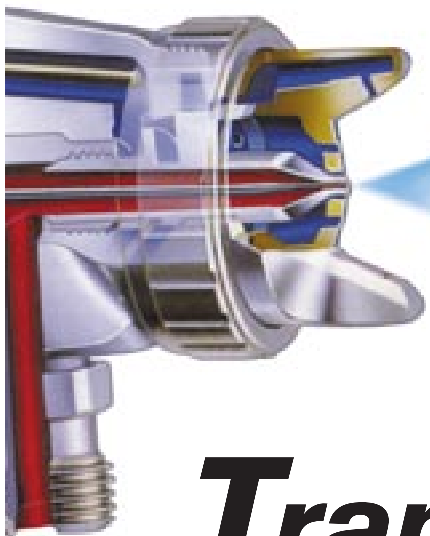

Spray systems vary considerably in 'transfer efficiency' – that is, the amount of liquid material actually deposited onto the work piece versus the total amount sprayed. Here, finishing-system expert Jeff LaSorella describes atomization technologies and the relative efficiencies of each while clearing up some common misunderstandings about the transfer efficiency of spray systems used in most refinishing operations.

Transfer Efficiency and your Spray Gun

By Jeff LaSorella

Before the emphasis in the last decade or so on reducing VOC emissions, most finishers and refinishers at all levels of the industry used conventional-type spray guns.

These spray guns delivered (and still deliver) outstanding finish quality but are extremely wasteful, rarely reaching more than 25% transfer efficiency. This means that 75% of the material sprayed is exhausted into the atmosphere and wasted, obviously contributing heavily to the VOC-emission problem.

In response to mandates from local and state governments, many finishers and refinishers have switched to more transfer-efficient, high-volume/low-pressure (HVLP) spray systems. In doing so, however, many have found that they have to sacrifice productivity to maintain an orange-peel-free finish quality or sacrifice finish quality to maintain productivity.

PRODUCTIVITY FACTORS

Productivity, which in this context is the amount of surface area coated in a given amount of time, corresponds directly to the amount of properly atomized liquid exiting the spray gun.

It takes a greater volume of air and higher air pressure to properly atomize increased amounts of liquid. If this amount of air is more than the available compressor or turbine can provide, or if the amount of air pressure required is more than is legally allowed for HVLP (usually 10 psi at the air cap), then production will have to be slowed to maintain finish quality.

With all its benefits, then, HVLP is not necessarily the best solution to raising transfer efficiency. The best way to illustrate this is to review the parameters of all the commonly available spraying technologies.

When considering the pros and cons of each technology, however, it is important to keep in mind that the range of transfer efficiency is a result not only of atomization technology but also of the geometry of the target or object and the ability of the operator to set the spray gun up properly and use an efficient spraying technique.

The following presents these comparisons in two ways – first with the characteristic performance of each system described separately, then with highlighted information presented as Table I.

To select the most efficient spraying technology for a specific application, you should consider the type of coating, the cost of the coating, the quality of finish you want, the geometry of the objects being sprayed and the level of production you want to achieve.

Conventional spray atomization is the oldest and most inefficient form of finish-atomization technology. Finish is supplied to a gun by either the pressure, suction or gravity method, and the solid fluid stream that exits the gun is impinged upon by numerous jets of compressed air that break up the stream into a finely atomized spray.

This technology produces a finish droplet and compressed-air mass moving at a high velocity towards the intended target. Because of this, the majority of the spray mass can literally bounce off the intended target and become overspray, resulting in a very low transfer efficiency.

Conventional spray equipment usually operates within the following parameters:

Fluid pressure:	Usually between 5 and 40 psi, but up to 100 psi
Atomizing air pressure:	5 to 100 psi
Atomizing air consumption:	10 to 35 cfm
Spray particle velocity:	Approximately 30 feet per second
Transfer efficiency range:	15% to 35%

HVLP is a form of conventional atomization, the distinction being that the volume of atomizing air is greater and the air pressure is lower. This produces a lower-velocity spray that increases transfer efficiency somewhat, but the large volume of air used still creates turbulence that inhibits system effectiveness.

There are two sources of air for HVLP spray guns: compressors and turbines. A compressor is capable of producing higher air pressure than the mandated 10 psi at the air cap, but running at a higher air pressure means breaking the law in some areas. Thinning the material so less air pressure is needed for good atomization results in greater VOC loss to the atmosphere and defeats the primary purpose of using HVLP as a pollution-reduction technology.

Most turbines produce considerably less than 10 psi at the air cap, so production is always affected in a negative way. There is less atomizing force working for you, so you have to slow down your application rate considerably to get an acceptably smooth, orange-peel-free finish.

HVLP spray equipment running off a compressor usually operates within the following parameters:

Fluid pressure:	Usually between 5 and 40 psi, but up to 100 psi
Atomizing air pressure:	Up to 10 psi
Atomizing air consumption:	10 to 50 cfm
Spray particle velocity:	Approximately 21 feet per second
Transfer efficiency range:	25% to 65%

HVLP spray equipment running off a turbine usually operates within the following parameters:

Fluid pressure:	Usually between 5 and 40 psi, but up to 100 psi
Atomizing air pressure:	3 to 9 psi
Atomizing air consumption:	N/A
Spray particle velocity:	Approximately 21 feet per second
Transfer efficiency range:	Approximately 65%

Airless sprayers develop atomization entirely by hydraulic pressure.

High fluid pressure, generated by a pump, pushes the finish through a small orifice causing the finish to break up into fairly coarse droplets. Because of the large particle size and the high force behind the stream, airless spraying is less controllable than conventional or HVLP spraying but is useful for applying a lot of finish quickly where a fine, orange-peel-free finish appearance is not required.

The operating parameters of airless spraying are:

Fluid pressure:	1800 to 6500 psi
Atomizing air pressure:	N/A
Atomizing air consumption:	N/A
Spray particle velocity:	Approximately 5 feet per second
Transfer efficiency range:	40% to 70%

Airmix spraying is a proprietary technology of Kremlin and is, as its name implies, atomization caused by a mixture of forces.

Low- to medium-range hydraulic pressure on the fluid, developed by a pump, forces the finish through a small orifice mounted in the air cap. This produces an initial fan of finish droplets that, with the assistance of slight air pressure, causes a uniform dispersion of finely atomized particles throughout the fan.

The air cap directs a relatively low-volume/low-pressure stream of atomizing air to blend into the fan rather than impinge on it and cause turbulence. This low-turbulence/low-velocity process allows for a high degree of control in depositing finely atomized materials onto the intended surface, resulting in a relatively high transfer-efficiency range.

Operating parameters of Airmix spraying are:

Fluid pressure: 300 to 1800 psi
Atomizing air pressure: 2 to 25 psi
Atomizing air consumption: 2 to 5 cfm
Spray particle velocity: Approximately 2 feet per second
Transfer efficiency range: 60% to 90%

Air-assisted airless spraying is similar to airmix spraying, but without Kremlin's exclusive air-cap technology.

Air-assisted airless (something of a misnomer, because the system doesn't normally operate within airless fluid-pressure ranges) uses medium-to-high fluid pressures and higher atomizing-air volume and air pressure than airmix spraying. Atomization is thus coarser, and transfer efficiency is slightly less as a result of the impingement-type atomization process and greater turbulence.

Operating parameters of an air-assisted airless system are:

Fluid pressure: 300 to 2500 psi
Atomizing air pressure: 15 to 75 psi
Atomizing air consumption: 5 to 20 cfm
Spray particle velocity: Approximately 3 to 5 feet per second
Transfer efficiency range: 40% to 75%

Spray System Comparison Table

Spray System	Fluid Pressure (psi)	Atomizing Air Pressure (psi)	Atomizing Air Consumption (cfm)	Approximate Spray Particle Velocity (feet/second)	Maximum Transfer Efficiency (%)
Conventional	Up to 100	5 to 100	10 to 35	30	35
Compressor HVLP	Up to 100	Up to 10	10 to 50	21	65
Turbine HVLP	Up to 100	3 to 9	N/A	21	65
Airless	1800 to 6500	N/A	N/A	5	70
Airmix	300 to 1800	2 to 25	2 to 5	2	90
Air-Assisted Airless	300 to 2500	15 to 75	5 to 20	3 to 5	75

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