Professional Refinishing

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Old From New

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Nozzles & Caps

A look inside spray-gun performance

PLUS

Making a case for NMP removers
Choosing Fluid Nozzles & Air Caps

By Paul Masters

When people ask me what they can do to get the most out of their spray guns, I have a simple answer. All the technique and all the experience in the world won't help you if you aren't aware of how the components at the business end of your spray gun do their jobs — and how you can work with them to increase overall performance.

Let me be more specific: Fluid nozzles and air caps are important parts of a spray gun and often can be switched out to improve the quality and efficiency of your work. This is so because the range of materials normally used in refinishing shops is quite varied when it comes to their sprayability.

So let's examine the role of fluid nozzles and air caps for conventional and HVLP (compressor and turbine) spray guns — the guns most refinishers use — and see how they can be used to your advantage.

HOW GUNS WORK

Spray guns atomize a fluid material — stain, finish, paint, adhesive — by impacting a fluid stream with compressed air generated by a compressor or with a large volume of air generated by either a compressor or a turbine as the stream is discharged from the front of the gun.

The air is supplied to the air inlet in the handle of the gun through a flexible hose; the fluid is commonly supplied to the front of the gun by one of four methods (Figure 1):

- Gravity from a cup that sits on top of the gun (Figure 1A)
- Suction from a cup attached to the underside of the gun (Figure 1B)
- Pressure through a tube into a cup under the gun (a turbine gun) (Figure 1C)
- Pressure through a flexible hose from a separate pressure pot (Figure 1D).

When you begin pulling the trigger of the gun towards the handle, the main air valve in the handle is opened, allowing air to pass through the gun and exit through the air cap. As you pull the trigger further, the fluid needle is retracted from the fluid nozzle, allowing fluid to exit through the orifice. Having the air activated before the fluid ensures that the fluid is fully atomized from the start (Figure 2).

When you release the trigger, springs return the fluid needle and main air valve to their closed positions.

You want to set up your gun to achieve two ends when spraying a liquid material onto an object: First, you want to atomize the material into a fine enough mist so you produce the least possible orange peel. Second, you want to shape the spray pattern so it covers the object efficiently with a minimum of waste from overspray (that is, spray
that goes wide of the object).

Both of these goals are affected by the fluid needle/nozzle combination and the air cap you choose.

**THE CRITICAL PARTS**

Let's take a closer look at the fluid nozzles and air caps found on common spray guns. (For illustration, refer again to Figure 2.)

- **Fluid Needle and Nozzle**: The fluid needle and nozzle are always sold as a pair according to the diameter of the orifice and must be used together to form a perfect fit (or seat) when the gun's trigger is released. (There are exceptions: Some newer fluid needles have a more gradual taper to accommodate several nozzles.)

The purpose of the fluid nozzle is to control the amount of fluid material that exits the spray gun. Larger fluid nozzles allow greater flow, while smaller nozzles restrict the flow. Sizes available for use with clear wood finishes such as lacquers and water-based
finishes range from about .02 inches (0.5 mm) up to .07 inches (1.8 mm). Larger sizes are available for thicker materials such as paints and adhesives.

Better quality spray-gun manufacturers offer fluid needles and nozzles in a number of sizes, but they often identify them with alphabetical lettering, numbering or colors that don't indicate the actual size. In such cases, you may have to contact the manufacturer to find out the actual measurements.

- **Air Cap:** The air cap, which is also called an air nozzle, is commonly sold and designed to be compatible with a specific fluid nozzle and needle. (This is called a nozzle set when all three parts are sold together.) But you can interchange air caps and fluid nozzles to vary or improve atomization. On compressed-air-supplied guns, you can also use a different air cap to change the width of the spray pattern or fan (Figure 3).

The air cap contains a number of holes through which air flows to atomize the fluid and shape the pattern (Figure 4). The air that comes through the center hole (the one that surrounds the fluid-nozzle orifice) and the other holes in the face of the air cap serves to atomize the fluid. The air that comes through the holes in the horns of the air cap shapes the pattern.

Air caps with more and larger holes in the horns create wider fan widths than do air caps with fewer and smaller holes. To accommodate an increased volume of air at lower pressures, the holes in air caps used with turbine HVLP guns are considerably larger than the holes in air caps used with compressed-air guns.

**MAKING CHOICES**

All spray guns come off the shelf with a general-purpose fluid nozzle and air cap that may work just fine for you, but the fact is that while they may work satisfactorily for some of the materials you spray, they may not do so well with others. You may be able to improve the quality of your work or your efficiency by changing out one or the other (or both) of these components.

There are five variables that will determine which nozzles and air caps will work best:

- The viscosity of the specific material you're spraying
- The amount of air (in cfm) your compressor or turbine produces
- The quality of results you want in your work
- The speed at which you want to spray
- The geometry (that is, the size and shape) of the object you're spraying.

Let's consider each of these in turn.

- **Viscosity:** The thicker the fluid you're spraying, the larger the fluid nozzle you should use. Conversely, the thinner the liquid, the smaller the nozzle. (For a detailed discussion of viscosity, see "Formulator's Notebook" on page 38.)

The explanation is quite obvious: Thicker liquids are harder to push through small holes than are thinner liquids. So if your fluid nozzle isn't large enough, less material will be discharged — which will result in your having to move the gun very slowly across the work to get enough material on the surface so it will flow together.

The exception is a pressure-pot set-up, where you could compensate for too small a nozzle by turning up the pressure from the pot. Doing this is unwise, however, because it forces the fluid out the nozzle at too great a velocity for the air to atomize it properly. As a rule, you should keep the pressure at the fluid regulator between 2 and 20 psi and switch to a larger fluid nozzle.

- **Amount of Air:** Manufacturers' recommendations for proper fluid nozzles and air caps always assume that you have an adequate supply of air measured in cfm.
This implies that the size of your compressor or the number of stages in your turbine is critical for achieving quality, orange-peel-free work. Unfortunately, many refinishers operate with too little air, and this affects the quality of their work.

It is possible to compensate, however, by choosing a smaller fluid nozzle and air cap. If you don't have enough air to operate your gun at full efficiency (meaning you can't operate it wide open without getting orange peel), the better the quality.

Orange peel is usually caused by moving the gun too fast over the work or by spraying too thick a material with too little air. To correct the first problem, move the gun slower, or use a larger nozzle set so that more fluid is discharged. To correct the second problem, thin the material you're spraying, or use a larger nozzle set and increase the amount of air to your gun.

In both cases, you can't correct the problem by switching to a larger nozzle set unless you have enough air. Without the required air, using the larger nozzle set will itself lead to orange peel.

- **Speed:** The speed at which you can move your gun over the work and get an orange-peel-free finish is determined by the amount of fluid material your gun can discharge. This is called the flow rate and is measured in ounces per minute.

- **Geometry:** To increase your efficiency (or decrease your waste), you need to take the size and shape of the work you're spraying into consideration. If you normally spray table tops, for example, you want a nozzle set that will give you the widest possible fan width so you'll need fewer passes to cover the table.

- **Quality:** The quality of your work is measured by the amount of orange peel in your finish. The less obvious the orange peel, and nozzle, so don't use this approach all the time.

One last point: In most cases, you'll use the air cap the manufacturer specifies for the fluid nozzle, but as long as you have enough air, you may be able to improve your atomization using thicker materials by substituting a larger air cap. Just watch that this doesn't blow a hole in the middle of your spray and create a split pattern.

![Diagram of spray gun components](image)

**Figure 4:** Seen here from two angles for clarity, the holes in the face of the air cap [including the center hole] direct air for atomizing the fluid material, while holes in the horns of the air cap direct air for shaping the spray pattern.

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