

Understanding Conventional & HVLP Spray Guns

Technical Bulletin

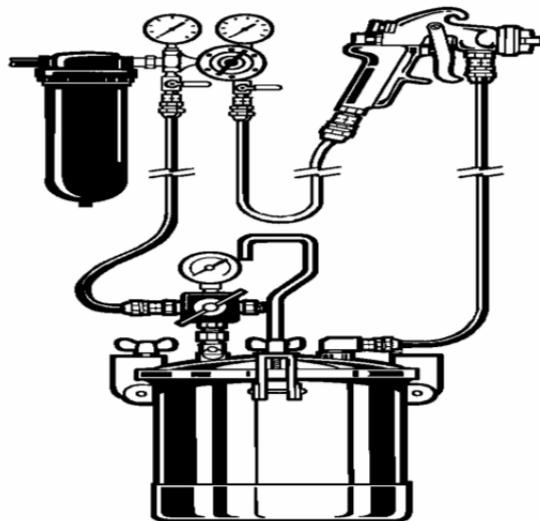
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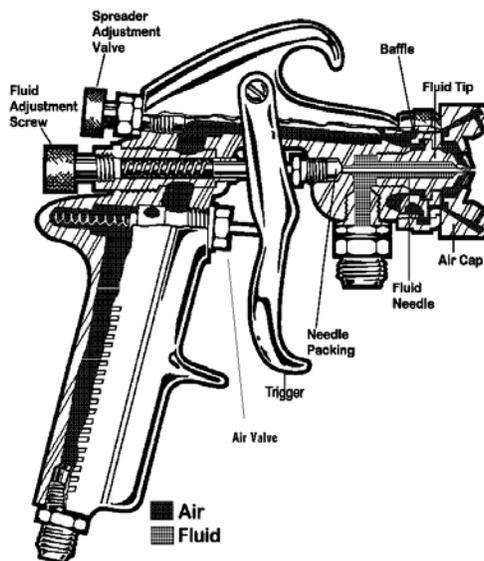
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What are the components of a pressure feed system?

A pressure feed system consists of; a pressure feed spray gun, a pressure feed tank, cup or pump, an air filter/regulator, appropriate length & diameter of air and fluid hoses and an adequate air compressor.



Air Atomizing Spray Guns



What happens when the trigger is pulled?

The trigger operates in two stages. Initial trigger movement opens the air valve, allowing atomizing air to flow through the gun.

Further movement of the trigger opens the fluid needle, allowing fluid material to flow. When the trigger is released, the fluid flow stops before the atomizing air flow.

This lead/lag time in the trigger operation, assures a full spray pattern when the fluid flow starts. It also assures a full pattern until the fluid flow stops, so there is no coarse atomization.

How is the pressure feed gun adjusted for spraying?

Open spreader adjustment valve for maximum pattern size.

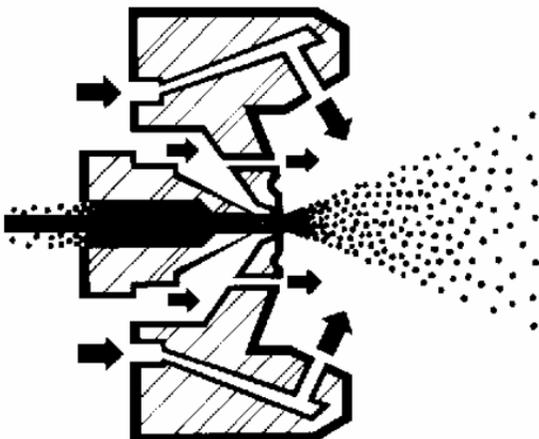
Open fluid adjustment screw (counter clockwise) until maximum needle travel is achieved. Opening beyond that point will lessen the internal spring tension and leakage at the fluid tip may result.

How is the pressure feed gun balanced for spraying?

- 1 Using control knob on fluid regulator, set fluid pressure at 5 to 10 psi.
- 2 Using control knob on air regulator, set air atomization pressure at 30-35 psi.
- 3 Spray a test pattern (fast pass) on a piece of paper, cardboard, or wood. From that test pattern, determine if the particle size is small enough and uniform throughout the pattern to achieve the required finish quality. If particle size is too large or is giving too much texture in the finish, turn the atomization pressure up in 3 to 5 psi increments until particle size and texture of finish is acceptable.
- 4 Spray a part with these settings. If you are not able to keep up with the production rate required or if the finish is starved for material, increase the fluid pressure (or use a larger capacity fluid tip) with the fluid regulator control knob in 2 to 4 psi increments until required wet coverage is accomplished.
- 5 Remember, as you turn up the fluid pressure the particle size will increase. Once the coverage required is obtained, it will be necessary to re-adjust the atomization pressure in 3 to 5 psi increments as explained in step 3 to insure required particle size and finish texture is achieved.
- 6 If using HVLP, using an "Air Cap Test Kit", verify that the air cap pressure is not above 10 psi if required by a regulatory agency.

What is an external mix gun?

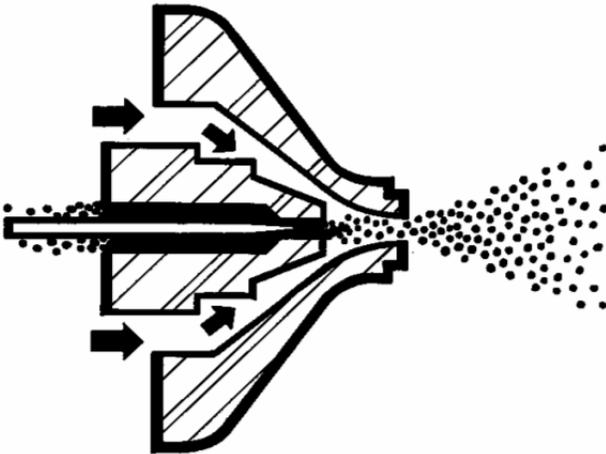
This gun mixes and atomizes air and fluid outside the air cap. It can be used for applying all types of materials, and it is particularly desirable when spraying fast drying paints such as lacquer. It is also used when a higher quality finish is desired.



What is an internal mix cap?

This gun mixes air and material inside the air cap, before expelling them. It is usually used where low air pressures and volumes are available, or where slow-drying materials are being sprayed.

A typical example is spraying flat wall paint, or outside house paint, with a small compressor. Internal mix guns are rarely used for finishing when a fast-drying material is being sprayed, or when a high quality finish is required.



What is HVLP?

HVLP, or High-Volume/Low Pressure, uses a high volume of air (typically between 15-26 CFM) delivered at low pressure (10 PSI or less at the air cap) to atomize paint into a soft, low-velocity pattern of particles. In most cases, less than 10 psi is needed in order to atomize.

Proper setup utilizes no more fluid and air pressure than is needed to produce the required quality and a flow rate that will meet production requirements.

As a result, far less material is lost in overspray, bounce-back and blowback than with conventional air spray. This is why HVLP delivers a dramatically higher transfer efficiency (the amount of solids applied as a percent of solids sprayed) than spray systems using a higher atomizing pressure.

The HVLP spray gun resembles a standard spray gun in shape and operation. Models that use high inlet pressure (20-80 psi) and convert to low pressure internally within the spray gun are called HVLP conversion guns.

Some HVLP models, particularly those using turbines to generate air, bleed air continuously to minimize back-pressure against the air flow of the turbine.

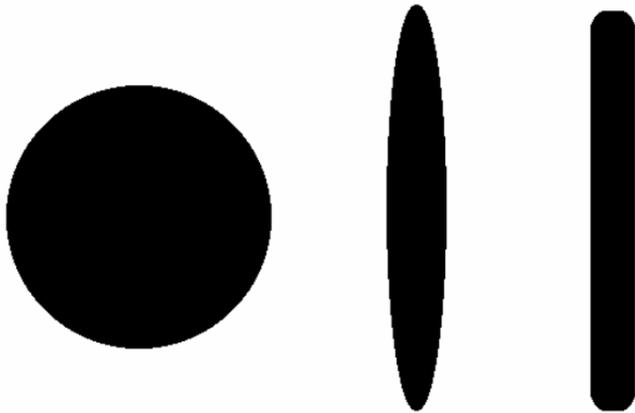
The air cap design is similar to that of a standard spray gun, with a variety of air jets directing the atomizing air into the fluid stream, atomizing it as it leaves the tip.

HVLP is growing in popularity and new environmental regulations are requiring it for many applications.

HVLP can be used with any low-to-medium solids materials that can be atomized by the gun, including two-component paints, urethanes, acrylics, epoxies, enamels, lacquers, stains, primers, etc.

What is the function of the air cap?

The air cap directs compressed air into the fluid stream to atomize it and form the spray pattern.



There are various styles of caps to produce different sizes and shapes of patterns for many applications.

What are the advantages of the multiple jet cap?

This cap design provides better atomization of more viscous materials.

It allows higher atomization pressures to be used on more viscous materials with less danger of split spray pattern.

It provides greater uniformity in pattern due to better equalization of air volume and pressure from the cap. It also provides better atomization for materials that can be sprayed with lower pressures.

How should an air cap be selected?

The following factors must be considered:

- a) Type, viscosity and volume of material to be sprayed
- b) Size and nature of object, or surface, to be sprayed (Multiple, or larger, orifices increase ability to atomize more material for faster painting of large objects. Fewer, or smaller, orifices usually require less air, produce smaller spray patterns and deliver less material. These caps are designed for painting smaller objects and/or using slower speeds.
- c) Material feed system used - pressure, siphon or gravity
- d) Size of fluid tip to be used (Most air caps work best with certain fluid tip/needle combinations.)
- e) Volume of air in cubic feet per minute (CFM) and pressure in pounds per square inch (PSI) available.

What is the function of the fluid tip and needle?

They restrict and direct the flow of material from the gun into the air stream. The fluid tip forms an internal seat for the tapered fluid needle, which reduces the flow of material as it closes.

The amount of material that leaves the front of the gun depends upon the viscosity of the material, the material fluid pressure and the size of the fluid tip opening provided when the needle is unseated from the tip.

Fluid tips are available in a variety of sizes to properly handle materials of various types, flow rates and viscosity's.

What is the nozzle combination?

In practice, the air cap, fluid tip, needle and baffle are selected as a unit, since they all work together to produce the quality of the spray pattern and finish. These four items, as a unit, are referred to as the nozzle combination.

How are nozzle combinations selected?

Five basic considerations are involved in selecting the nozzle combination:

- Type and viscosity of material being sprayed
- Physical size of object being finished
- Desired speed/finish quality
- Gun model being used
- Available air volume (CFM) and pressure (PSI) from compressor

1. The type and viscosity of the material being sprayed is the first factor to consider. Rule of thumb: The lower the viscosity of the material, the smaller the I.D. of the fluid tip.
2. The physical size of the object to be painted must also be considered. As a general rule, use the largest possible spray pattern consistent with the object size. Remember that different air caps deliver various pattern characteristics. This can reduce both spraying time and the number of gun passes.
3. The next consideration in evaluating nozzle combinations is the speed with which the finish will be applied, and the desired level of quality.

For speed and uniform coverage, choose a nozzle combination which produces a pattern as wide as possible.

For finish coat work, quality is the deciding factor. Choose a nozzle combination which produces a fine atomization and a smaller pattern size, thereby giving greater application control.

4. The model of the gun itself will limit the selection of nozzle combination.

For a pressure feed gun, the amount of material discharged depends upon material viscosity, the inside diameter of the fluid tip, the length and size of hose and the pressure on the material container or pump.

If the fluid tip opening is too small, the paint stream will be too high. If the fluid tip opening is too large, you will lose control over the material discharging from the gun.

5. Available air supply is the last factor to consider.

Pressure feed air caps consume between 7.0 and 26.0 CFM, depending on air pressure applied. If your air supply is limited, because of an undersized compressor, or many other air tools are in use at once, the gun will be starved for air, producing incomplete atomization and a poor finish.

What are the criteria for selecting a pressure feed nozzle?

While the fluid discharge in ounces per minute from a suction feed gun is relatively stable (largely because it is determined by atmospheric pressure), the fluid discharge from a pressure feed gun depends more upon the size of the inside diameter of the fluid tip and the pressure on the paint container or pump. The larger the opening, the more fluid is discharged at a given pressure.

If the fluid tip ID is too small for the amount of material flowing from the gun, the discharge velocity will be too high. The air, coming from the air cap, will not be able to atomize it properly causing a center-heavy pattern.

If the fluid tip opening is too large, material discharge control will be lost, often resulting in a split pattern.

The fluid tip/air cap combination must be matched to each other and to the job at hand. Spray gun catalogs include charts to help you match them properly.

Viscosity control is an extremely important and effective method to maintain application efficiency and quality consistency.

What is the spreader adjustment valve?

A valve for controlling the air to the horn holes which regulate the spray pattern from maximum width down to a narrow or round pattern.

What is the fluid needle adjustment?

This adjustment controls the travel of the fluid needle, which allows more or less material through the fluid tip.

With pressure feed systems, the fluid delivery rate should be adjusted by varying the fluid pressure at the pressure pot. Use the fluid adjustment knob for minor and/or temporary flow control. This will extend the life of the fluid needle and tip.

How should the spray gun be held?

It should be held so the pattern is perpendicular to the surface at all times.

Keep the gun tip 12-18 inches (conventional air spray guns) or 8-12 inches (HVLP guns) from the surface being sprayed.

What is the proper technique for spray gun stroke and triggering?

The stroke is made with a free arm motion, keeping the gun at a right angle to the surface at all points of the stroke.

Triggering should begin just before the edge of the surface to be sprayed is in line with the gun nozzle. The trigger should be held fully depressed, and the gun moved in one continuous motion, until the other edge of the object is reached. The trigger is then released, shutting off the fluid flow, but the motion is continued for a few inches until it is reversed for the return stroke.

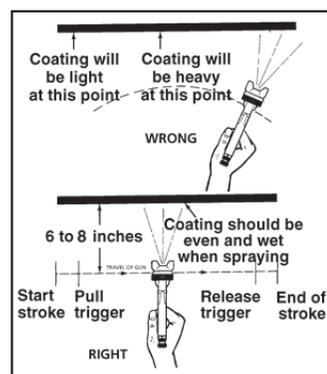
When the edge of the sprayed object is reached on the return stroke, the trigger is again fully depressed and the motion continued across the object.

Lap each stroke 50% over the preceding one. Less than 50% overlap will result in streaks on the finished surface. Move the gun at a constant speed while the trigger is pulled, since the material flows at a constant rate.

Another technique of triggering is referred to as "feathering." Feathering allows the operator to limit fluid flow by applying only partial trigger travel.

What happens when the gun is arced?

Arcing the stroke results in uneven application and excessive overspray at each end of the stroke. When the tip is arced at angle 45 degrees from the surface approximately 65% of the sprayed material is lost.



What is the proper spraying sequence and technique for finishing applications?

Difficult areas, such as corners and edges, should be sprayed first. Aim directly at the area so that half of the spray covers each side of the edge or corner.

Hold the gun an inch or two closer than normal, or screw the spreader adjustment control in a few turns.

Needle travel should be only partial by utilizing the "feathering" technique. Either technique will reduce the pattern size.

If the gun is just held closer, the stroke will have to be faster to compensate for a normal amount of material being applied to smaller areas.

When spraying a curved surface, keep the gun at a right angle to that surface at all times. Follow the curve. While not always physically possible, this is the ideal technique to produce a better, more uniform, finish.

After the edges, flanges and corners have been sprayed, the flat, or nearly flat, surfaces should be sprayed.

Remember to overlap the previously sprayed areas by 50% to avoid streaking.

When painting very narrow surfaces, you can switch to a smaller gun, or cap with a smaller spray pattern, to avoid readjusting the full size gun.

The smaller guns are usually easier to handle in restricted areas. A full size gun could be used, however, by reducing the air pressure and fluid delivery and triggering properly.

Hoses & Connections

The various types of hose used to carry compressed air and fluid material to the spray gun are important parts of the system. Improperly selected or maintained hose can create a number of problems.

There are two types; air hose - used to transfer compressed air from the air source to the gun, and fluid hose - used in pressure feed systems to transfer the material from its container to the spray gun.

What sizes of air hose are recommended?

The hose from the compressor to the pressure tank should be a minimum of 3/8" – 1/2" ID.

The hoses from the pressure tank regulator to the gun should be a minimum of 3/8" – 1/2" ID.

Tools requiring more air may need larger I.D. and or shorter hoses.

What is pressure drop?

This is the loss of air pressure due to friction (caused by air flow) between the source of the air and the point of use. As the air travels through the hose or pipe, it rubs against the walls. It loses energy, pressure and volume as it goes.

How can this pressure drop be determined?

At low pressure, with short lengths of hose, pressure drop is not particularly significant. As pressure increases, and hose is lengthened, the pressure rapidly drops and must be adjusted.

All air hose is subject to pressure loss or drop.

For example, 1/4" pressure drop is 1 psi per foot and 5/16" is 1/2 psi per foot. This pressure loss may result in poor atomization.

Too often, a tool is blamed for malfunctioning, when the real cause is an inadequate supply of compressed air due to an undersized ID hose.

For optimum spray gun results, the following minimum is recommended: up to 20 ft – 3/8" I.D. and over 20 ft - up to 25 ft.- 1/2" I.D.

The control of the volume, the pressure and the cleanliness of the air entering the spray gun are of critical importance to the performance of the system.

Following some key installation principles will help decrease the risk of contaminants. For example, it's important to use the right size air compressor for your application. An overworked air compressor can produce a significant amount of dirt and oil.

Additionally, proper piping is very important to help prevent condensation from forming within the line and contaminating the air supply.

What is air control equipment?

Any piece of equipment installed between the air source and the point of use that modifies the nature of the air stream.

Why is air control equipment necessary?

Raw air, piped directly from an air source to a spray gun, is of little use in spray finishing. Raw air contains small, but harmful, quantities of water, oil, dirt and other contaminants that will alter the quality of the sprayed finish. Raw air will likely vary in pressure and volume during the job.

There will probably be a need for multiple compressed air outlets to run various pieces of equipment. Any device, installed in the air line, which performs one or more of these functions, is considered to be air control equipment.

What are the types of air control equipment?

Air control equipment comes in a wide variety of types, but it basically all performs one or more of the following functions; air filtering/cleaning, air pressure regulation/indication and air distribution through multiple outlets.

What is an air regulator?

This is a device for reducing the main line air pressure as it comes from the compressor. Once set, it maintains the required air pressure with minimum fluctuations.

Regulators are used in lines already equipped with an air filtration device.

Air regulators are available in a wide range of CFM and PSI capacities, with and without pressure gauges and in different degrees of sensitivity and accuracy.

They have main line air inlets and regulated or non-regulated air outlets.

What causes excessive pressure drop on the main line gauge of the filter/regulator?

- a) The compressor is too small to deliver the required air volume and pressure.
- b) The compressor is not functioning properly.
- c) There is leakage in the air line or fittings.
- d) Valves are partially opened.
- e) The airline is too small for the volume of air required.
- f) Quick connector check valves are restricting air flow.

Respirators

Spray finishing creates a certain amount of overspray, hazardous vapors and toxic fumes. This is true, even under ideal conditions, and there is no way to avoid it entirely. Anyone near a spray finishing operation should use some type of respirator, or breathing apparatus.

What is a respirator?

A respirator is a mask that is worn over the mouth and nose to prevent the inhalation of overspray fumes and vapor.

Why is a respirator necessary?

For two reasons: First...some type of respiratory protection is required by OSHA/NIOSH regulations.

Second...even if it wasn't a requirement, common sense tells you that inhaling overspray is not healthy.

Overspray contains toxic particles of paint pigments, harmful dust and vapor. Exposure to any of the above is a potential health risk.

Depending on design, a respirator can remove some, or all, of these dangerous elements from the air around a spray finishing operator.

What types of respirators are used by spray finishing operators?

There are three primary types; the air-supplied respirator, the organic vapor respirator and the dust respirator.

What is a dust respirator and where is it used?

Dust respirators are sometimes used in spray finishing but, in most applications, they are unsatisfactory.

These respirators are equipped with cartridges that remove only solid particles from the air. They have no ability to remove vapors.

They are effective, however, in preliminary operations such as sanding, grinding and buffing.

NOTE: Before using any respirator, carefully read the manufacturer's Safety Precautions, Warnings and Instructions. Many respirators are not suitable for use with isocyanates, asbestos, ammonia, pesticides, etc.

Air Compressors

All air tools, spray guns, sanders, etc., must be supplied with air which is elevated to the higher pressures and is delivered in sufficient volume. The air compressor compresses air for use in this equipment and is a major component of a spray painting system. This chapter will examine the various types available.

Compressed air is measured on the basis of the volume supplied per unit of time (cubic feet per minute, or CFM) at a given pressure per square inch (PSI), referred to as delivery. Displacement is the output of air by a compressor at zero pressure, or free air delivery.

What is an air compressor?

An air compressor is a machine designed to raise the pressure of air from normal atmospheric pressure to some higher pressure, as measured in pounds per square inch (psi). While normal atmospheric pressure is about 14.7 pounds per square inch, a compressor will typically deliver air at pressures up to 175 psi. When selecting a compressor:

Rule of thumb the cubic feet per minute delivered by an electrically powered 2 stage *industrial* air compressor is 4 times the motor's horse power rating. (CFM=4xHP)

What types of compressors are most common in spray finishing operations?

There are two common types; the piston-type design and the rotary screw design.

Because most commercial spray finishing operations consume large quantities of compressed air at relatively high pressures, the piston type compressor is the more commonly used.



Corporate Office

Parex USA, Inc.
4125 E. La Palma Ave., Suite 250
Anaheim, CA 92807
(866) 516-0061
Tech Support: (800) 226-2424

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