

# The Effect of Air Restrictions on Spray Finishing

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Figure 1. Large vs. small capacity quick-disconnects (above) and 1/4-inch vs. 3/8-inch air hose diameters.

Just when you think 1/4-inch air hoses are a thing of the past, you visit a manufacturing facility that is running over 100 feet of it from their main air line to their spray booth. At the spray booth, the line is plumbed through numerous fittings and quick-disconnects on its way to some sort of air filtration system. The air might then be plumbed through some sort of air regulator fitted with a pressure gauge that is either dysfunctional or is covered with so much overspray that you can't tell its dysfunctional. Does any part of this (or all of it) sound familiar? The purpose of this article is offer some insight on how common air restrictions might affect your air spray finishing operation.

## Air Spray Atomization and Air Restrictions

With conventional or high volume-low pressure (HVLP) air spray, atomization energy imparted by compressed air from the air cap is used to break up the fluid stream from the spray gun. In regard to atomization energy, conventional air spray guns rely more on air velocity to break up the fluid stream. HVLP atomization energy, on the other hand, relies more heavily on the mass of air from the air cap. In any case, air restrictions reduce atomization energy and may cause disappointing results with respect to finish quality, particularly when using HVLP equipment.

The following are some common sources of air restrictions:

### **Small Diameter Air Hoses**

Small diameter air hoses should be a thing of the past. However, it is not unusual to find 1/4-inch hoses being used to supply atomizing air to a spray gun. Small diameter hoses starve the spray gun of air. For air spray equipment, 3/8-inch hoses are best (particularly for HVLP spray guns) although 5/16-inch may be just fine for short hose runs (see Figure 1).



Figure 2. Various fittings and plumbing arrangements.

**Excessive Hose Lengths** Using a 50-foot length of air hose in a spray booth where a 10-foot length would suffice does not make sense from an air supply perspective. The excess hose length also makes for some interesting ergonomics and challenging footwork.

**Low Capacity QDs** Spray guns are often fitted with quick disconnects for convenience and ergonomics. In regard to flow capacity, QDs are not all the same. Most spray finishing facilities use small diameter QDs that contribute to their existing air restriction problems. For best performance, small diameter QDs should be replaced with high capacity QDs (see Figure 1).

### Piecemeal Plumbing

Creativity is often reflected in a facility's air plumbing work. Examples of piecemeal plumbing include 1/4-inch coil hose, small inside diameter 90 degree galvanized pipe elbows, air line splices, and a series of fittings that oscillate from 3/16- to 1- inch inside diameter (see Figure 2).

### Effect of Air Restrictions

Table 1 illustrates how some of the above scenarios affect airflow and atomizing energy (in terms of air cap pressures) for a variety of HVLP spray guns. For each trial, the flow meter outlet pressure was maintained at 50 psi and the spray gun's shaping air valve was fully open. The length of air hose used was also kept at 25 feet. Variables included in Table 1 include the inside diameter of the air hose, the size of the QDs used at each end of the air hose, and variations in the plumbing from the flow meter outlet (i.e., a straight plumbing run vs. a 90 degree bend). Figure 3 illustrates the various scenarios included in the measurements.

table 1					
Air Restriction Effects on Air Flow and Air cap Pressures					
Spray Gun Number	Air Hose I.D.	QD Capacity	Piping Run	Air Flow scfm	Air Cap Pressure Atomizing Air/Shaping Air
1	1/4-inch	Large	Straight	10.8	ND
1	3/8-inch	Large	Straight	15.5	ND
2	1/4-inch	Large	Straight	12.4	3.0 psi/2.0 psi
2	3/8-inch	Large	Straight	22.3	8.2 psi/6.1 psi
2	1/4-inch	Small	90° Elbow	10.5	2.5 psi/1.4 psi
2	3/8-inch	Small	90° Elbow	16.1	4.5 psi/2.8 psi
3	1/4-inch	Large	Straight	10.8	3.5 psi/1.0 psi
3	3/8-inch	Large	Straight	16.1	6.5 psi/3.8 psi

## Results

As indicated in Table 1, the use of 1/4-inch air hose, small diameter QDs and indirect plumbing have an adverse effect on HVLP air output and air cap pressures. Reducing the inside diameter of a 25-foot air hose from 3/8 to 1/4 of an inch reduced the spray gun's air output by approximately 30 to 44 percent. It also reduced atomizing air cap pressures by approximately 44 to 63 percent.

Use of small QDs and indirect piping for each hose diameter showed similar results. As shown in Table 1, airflow output and atomizing pressure (at the air cap) using the 3/8-inch hose and 90 degree plumbing were 28 and 45 percent less, respectively, than that obtained for the same hose diameter, large QDs and a straight plumbing run. Similar (but less dramatic) results were obtained for the 1/4-inch air hose.

In short, lower airflow output and air cap pressures mean less atomization energy. As a result, restrictive plumbing may prevent air spray guns (particularly HVLP) from producing an acceptable finish. This may cause the operator to become discouraged with the spray gun or reduce the viscosity of the coating through increased solvent additions. Fortunately, these types of air restrictions are easily remedied once recognized.