INTRODUCTION
TO
SPRAY PAINTING

WHERE IS SPRAY PAINTING USED

SPRAY PAINTING LIMITATIONS

WHERE IS SPRAY PAINTING USED?

Spray painting methods are used almost everywhere paint is applied such as:

- Interiors and exteriors of residential, commercial, industrial, and farm buildings
- Bridges and other steel structures
- Refinishing projects
- Manufacturing

Spray painting is particularly economical for rough and irregular substrates such as structural steel, metal decking, and concrete products.

Choosing the right spray system for a job depends on a number of factors. Many of these factors deal with the substrate, the type of paint, and job production requirements.

SPRAY PAINTING LIMITATIONS

There are only a few types of job conditions under which spray equipment is not practical. The main factor limiting the use of spray equipment is that the work area may present a fire or other type of safety hazards that cannot be overcome. Another spraying limitation is that it may be impossible, or impractical, to properly cover, shield, or mask objects or surfaces in the work area that are not to be painted.

Other types of problems that limit the effectiveness of using spray equipment concern the skill of the spray painter, the condition of the substrate, and the condition of the spray equipment. The materials to be used are also an important consideration when using any spray system.

The spray painting equipment used on a job may affect the quality of the finished work. Problems concerning equipment and materials may be caused by:

- Spray equipment that is undersized for the job
- Using incorrectly sized paint hoses
- Improper air supply or paint pressure for spraying
- Damaged equipment
- Not following manufacturers instructions for the preparation of paints and coatings for spraying

It is important for the spray painter to develop proper spray techniques and to always remember to use proper safety equipment.

ATOMIZATION

Atomization refers to the process of breaking up bulk liquids into droplets. Common examples of atomization include:

- Showerheads
- Perfume sprays
- Garden hoses
- Deodorant or hair sprays

A classic example of atomization occurring naturally involves pouring liquid from a pitcher. As you are pouring, gradually lift the pitcher higher. As you tilt the pitcher higher, the stream of liquid elongates and breaks into droplets at some point. This breakup of a liquid is a simplistic example of atomization.

The thickness or viscosity of the liquid being atomized is also an important factor in the ability of any liquid to be atomized.

A spray is a collection of moving droplets that are the result of atomization. Naturally occurring sprays are rain and ocean sprays. See Figures 14 and 15 for an illustration of a spray from the nozzle of a spray gun. Note that there are a variety of droplet sizes in the spray illustration. It is also important to understand that a droplet is a small particle of liquid. Droplets are also known as particles.

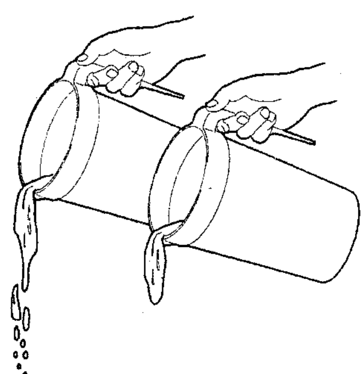


Figure 14— *Atomization of a stream of liquid.*

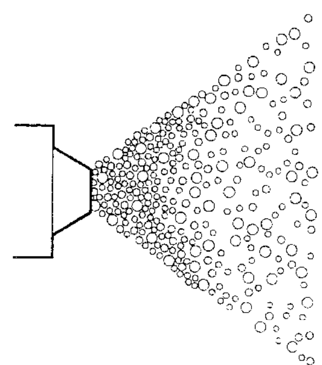


Figure 15— *A spray stream with a variety of droplet sizes.*

Besides transfer efficiency and overspray, other specific advantages and disadvantages of the major spray systems will be covered in the following introductory overview of the four major spray systems.

THE FOUR MAJOR SPRAY SYSTEMS

INTRODUCTION TO THE FOUR MAJOR SPRAY SYSTEMS

There are four major spray systems:

- Airless
- Conventional
- Electrostatic
- High Volume Low Pressure (HVLP)

Even though each of the four spray systems is different from one another, they all function as equipment that mechanically applies coatings to a variety of substrates.

AIRLESS SPRAYING

AIRLESS SPRAYING

The most widely used of the four major spray systems is airless spraying. Airless spraying, as the name implies, does not require air to atomize the spray. Simply speaking, airless sprayers pick up paint from a paint source, and with a pump, push the paint through a spray tip.

Spray tips come in a variety of types and sizes. It takes tremendous pressure to push paint through a spray tip. The pump is responsible for creating enough pressure for the paint to be pushed through the spray tip. Atomization takes place after the pushed paint leaves the spray tip due to the pressure being created by the spray pump. The pressure of the paint leaving the spray tip is measured in pounds per square inch (psi). Airless sprayers can create anywhere from 500 to 5000 psi. The major components of an airless system are:

- pump (picks up paint from paint source and delivers pressurized paint to the spray gun via hoses)
- hoses (deliver paint from the pump to the spray gun)
- spray gun (receives pressurized paint from pump, via hoses, and atomizes the paint as it leaves the spray gun)

VISCOSITY

Viscosity, the actual thickness of a coating, is the dominant factor in determining droplet size, which in turn directly affects how easily a liquid atomizes. Viscosity affects the fluid's ability to resist agitation, tending to prevent its breakup and leading to a larger average droplet size upon atomization. The thicker a coating is, the more difficult it is to atomize. As you can see in Figure 16, thicker viscosity materials have poor atomization characteristics, while thinner viscosity materials have increased atomization properties.

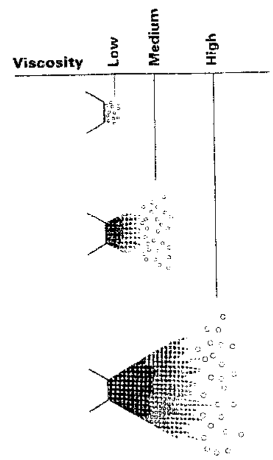


Figure 16—*Viscosity, droplet size, and when atomiztion occurs*

TRANSFER EFFICIENCY

The transfer efficiency of a spray finishing process is the amount of material that adheres to the target compared to the amount of material that was actually sprayed toward the target. Transfer efficiency is usually expressed as a percentage of the weight of solids sprayed versus the weight of solids received by the target. As painters, we call our 'target' a substrate. As an example, 60% transfer efficiency means that 60% of the weight of the solids in the material that was sprayed actually reached the target. The remaining 40%, which did not reach the target, is commonly referred to as overspray. Transfer efficiency is critical to the spray finishing industry from a cost and a regulatory standpoint. Figure 17 illustrates the concept of transfer efficiency by showing the amount of material reaching the target as only a portion of the total amount of material that is sprayed.

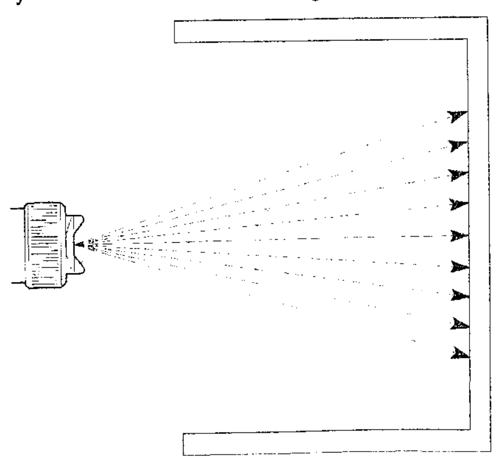


Figure 17—*Artificial Conditions for Achieving a High Rate of Transfer Efficiency*

When a greater percentage of material adheres to the target, less material is needed to achieve the desired film thickness. Improved transfer efficiency is a major objective for the spray finishing industry by lowering material and cleaning costs.

There are many factors that influence the efficiency of the transfer of materials to the target. The factors that affect transfer efficiency must be understood if the goal of optimal transfer efficiency is to be met. The primary spray finishing conditions that impact transfer efficiency are:

- Substrate characteristics, such as size and shape
- Skill level of sprayer
- Viscosity, atomization and spray finishing methods
- Equipment characteristics
- Air conditions, such as: - humidity - temperature - wind velocity

Sprayer skill alone can account for a 20 to 50% (or even higher) difference in transfer efficiency. With variables being as equal as possible, the general transfer efficiencies for the four major spray systems are:

Electrostatic	=	85%
HVLP	=	65% to 85%
Airless	=	50% to 60%
Conventional	=	25% to 45%

OVERSPRAY

As mentioned when defining the concept of transfer efficiency, overspray is what is 'leftover' from the atomization process (the amount of material atomized that does not reach the intended target substrate). Overspray is a major concern that has to be dealt with in any spray application. Specific areas that must be addressed concerning overspray:

- Masking (such as sprinkler heads or door trim), or covering-up (such as floors and furniture) of items in the immediate spray area that are not to be sprayed.
- Drifting (the wind is capable of carrying overspray material hundreds of yards 'down wind' from the spraying operation).
- Respiratory protection.
- Atomization pressure (the more you increase air or fluid pressure to a spray gun, the more overspray you have).
- The choice of spray equipment is directly related to the amount of overspray.
- Electrostatic 15% overspray.
- HVLP 15 to 35% overspray.
- Airless 40 to 50% overspray
- Conventional 55 to 75% overspray.

SPRAY TIPS

When using an airless spraying system, the airless spray is atomized (broken up) into a fluid composed of tiny droplets, without the use of compressed air. A coating is pumped under high pressure through a fluid hose to the spray gun, which delivers the coating through the tip. The tip controls the flow of material and creates the spray pattern. The specific functions of an airless spray tip are:

1. Determine the fluid flow or amount of the coating applied.
2. Create back pressure in the line for an evenly atomized pattern.
3. Create the spray pattern and fan width.

Spray tips come in various styles, but the most common style of spray tip is the "RAC" tip. "RAC" is an abbreviation for reverse-a-clean (or commonly referred to in the field as a reversible tip). There are two great advantages of using RAC tips. First of all, these tips are easy to unclog. Secondly, RAC tips are much safer since sprayers do not have to have their fingers in front of the tip to perform 'unclogging'. Figure 2-14 is an illustration of a common RAC tip.

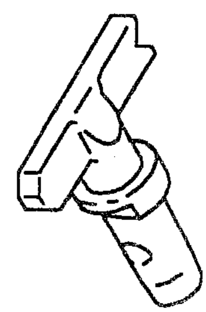


Figure 2-14—*Common RAC Tip*

It needs to be pointed out that even though it is relatively easy to unclog a RAC tip by reversing it, you must do so correctly. Many sprayers have accidentally gotten covered in paint by not paying attention during the reversing process. When using a RAC tip, it is important that you rotate the tip all the way until it stops (the tip actually has a shoulder that stops the tip rotation when you are cleaning the tip) before triggering the spray gun. It is important to know that the top of RAC tips have an arrow shape, the 'notch' is at the back and the point is at the front of the tip.

Spray tips are usually identified by a numerical system. By looking at the notched part of the spray tip (see Figure 2-15), a 3-digit number can be seen.

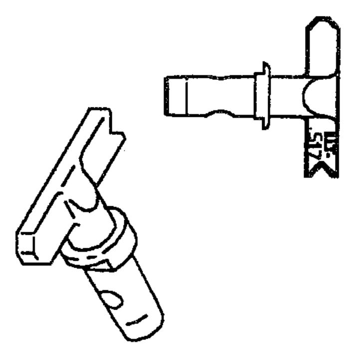


Figure 2-15—*Common RAC Tip*

The three-digit number refers to two different things. Figure 2-15 has the number .517 stamped on it. The first number, in this case the number 5, refers to the fan width of the tip. To determine the fan width, at 12 inches from the substrate being sprayed, you simply multiply the first number (in this example the number 5) by 2 to determine the fan width of the spray tip. The .517 tip will have a fan width of approximately 10 inches (2 times the first number, which was 5) at 12 inches from the substrate. An applicator determines the appropriate fan width when selecting a fan tip based on the substrate. For example, an applicator may choose a .311 spray tip, which would give you a 6-inch fan width at 12 inches from the substrate. Another example of spray tip selection would be an applicator choosing a .519 spray tip when spraying drywall, resulting in a 10-inch fan width. The remaining two digits (in the original example, the number 17) refer to the actual spray tip width. Tips are measured in thousandths of an inch increments, so the number 17 means that the tip has a width of 17 thousandths of an inch (.017). Thinner materials are sprayed with tips that have smaller openings. Below you will find a listing of commonly sprayed coatings and their recommended tip size.

Recommended Width

Tip Sizes Material	Tip Width
lacquer and stain	.011 to .013
oil based paint	.013 to .015
average latex paint	.015 to .019
heavy water based	.021 to .025
block filler	.025 to .035

Spray tip wear will vary because it is dependent upon the coating being sprayed. Three common rules-of-thumb for spray tip wear are:

1. Tip wear occurs with normal use.
2. The greatest wear occurs within the first 30 gallons of material sprayed.
3. Most tips are worn out after 100-150 gallons.

Tips are expensive, and there is no reason why we shouldn't help out our employers in getting the most for their spray tip buck.

There are six basic causes of premature spray tip wear:

1. Excessive pressure
2. Abrasive material
3. Paint not strained
4. Filters not used
5. Wrong size filters
6. Old and/or dirty hose

COMMON SPRAYING PROBLEMS

PROBLEMS AND POSSIBLE CAUSES

Orange peel
- Inadequate atomization
- Insufficient solvent or thinner
- Gun held too close to the surface or moved too slowly, causing the finish to ripple

excessive pot pressure

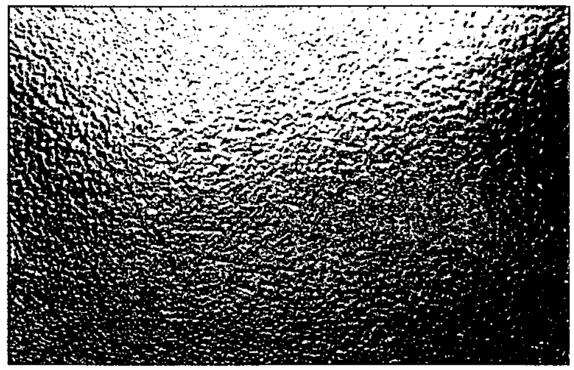
Dry spray
- Excessive atomization
- Overspray falling on already-sprayed surface
- Gun held too far from the surface or moved too rapidly

Runs or sags
- Finish applied too heavily
- Gun held too close to the surface or moved too slowly
- Finishing material thinned too much
- Trigger not released at the end of each stroke when the stroke doesn't go beyond the object
- Gun not held perpendicular to the surface

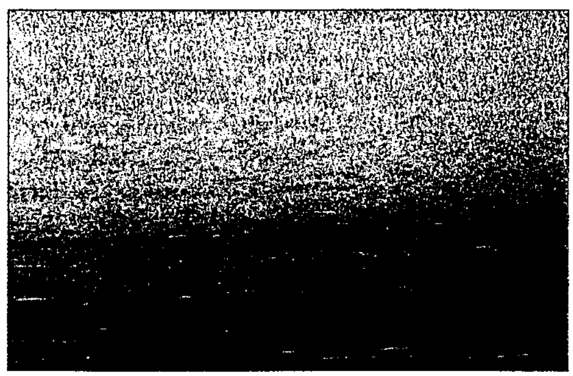
Gun sputters
- Clogged air vent in cup lid
- Finishing material is too thick
- Insufficient material in the cup or tipping the cup at an acute angle
- Leaky connection at fluid nozzle or needle-valve packing nut

Finish leaks from fluid nozzle of spray gun
- Needle-valve packing nut too tight
- Needle-valve packing itself in need of oil
- Damaged fluid-nozzle tip or needle-valve stem
- Wrong size needle-valve stem
- Worn or broken needle-valve stem spring

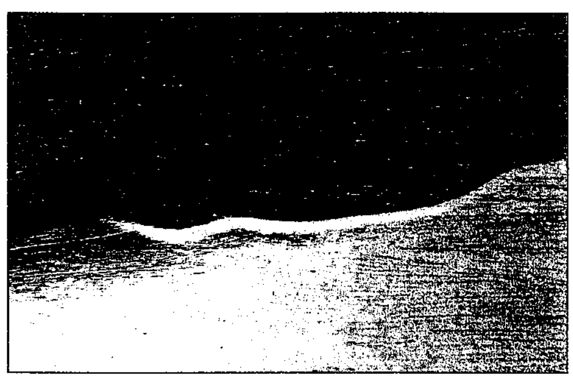
Finish leaks from cup
- Worn-out gasket



Orange peel.



Dry spray.



Runs or sags.