

Unit VII – Painting and Finishing

Lesson 1: Spray Painting and Finishing

Spray painting is a fast way to apply a uniform finish. Students in agricultural mechanics should be familiar with spray equipment and its operation, and they should practice spray painting to develop the correct technique. This lesson provides basic guidelines for spray painting. Your instructor must be present to demonstrate the step-by-step procedures for spray painting and guide you through them.

Safety Precautions for Spray Painting

As with all tasks in agricultural mechanics, safety considerations must come first. If not used properly, paints and solvents can cause fire, poisoning, eye and skin irritation, and respiratory problems. Improper use of painting equipment can lead to fire and other accidents. The following safety precautions should be observed in the painting process.

- **Follow safety procedures for all equipment and materials used in preparation or for painting.** This includes spray equipment, steam cleaners, sanders, and ladders, as well as paints and solvents. Read the labels on finishing materials to check for warnings about toxicity and flammability. Follow the manufacturer's instructions for safe operation of equipment.
- **Wear appropriate protective clothing and gear.** Wear safety glasses or goggles to protect eyes from splattered paints or solvents. Be aware of the location of an eye-washing station in case of an accident. Wear an approved respirator to protect the respiratory system from paint particles or toxic fumes. Wear rubber gloves to protect hands from burns and irritation when handling bleaches, solvents, or other caustic materials.
- **Work in a well-ventilated area.** Apply finishing materials outdoors if weather permits. If indoors, apply spray paint in a booth that is equipped with proper ventilation.
- **Keep sparks and flames out of the work area.** Many of the materials used in painting, including the cleanup rags, are flammable. The vapors and gases these materials produce are flammable as well. Do not smoke or allow others to smoke in the area.

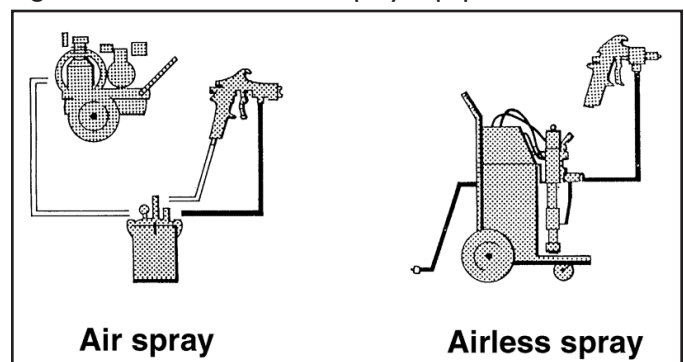
Keep equipment that can cause a spark away from finishing materials and the work area.

- **Have an approved fire extinguisher readily available.** Know the location of the fire extinguisher and how to use it.
- **Do not point a spray gun, especially the airless type, at any part of the body or at anyone else.** An airless gun is especially hazardous because it maintains liquids at high pressure. If the liquid is sprayed on the skin, it has sufficient force to penetrate the skin and cause damage. Seek medical attention immediately if this occurs. Remember that shutting off the pump of an airless spray system does not release the pressure. The system remains under pressure until the pressure is discharged through the spray gun.
- **Observe safe cleanup procedures.** Clean spills as they happen to prevent accidents. Use the appropriate solvent or cleaning solution for the task. Store chemicals in approved containers and flammable finishes and solutions in a fireproof cabinet. Keep the work area clear of debris and dispose of cleanup rags properly. Wash hands after working with chemicals that are toxic or could harm skin.

Types of Spray Equipment

Spray painting saves time and labor when compared with using a paintbrush or roller, especially for large surfaces. This method also produces a smoother finish, without brush or roller marks. A variety of spray equipment is available for various applications. The two basic types that are commonly used in agricultural mechanics shops are air and airless spray equipment. See Figure 7.1.

Figure 7.1 – Air and Airless Spray Equipment



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Air Spray Equipment

Air spray equipment uses compressed air to atomize (form into a fine spray) the paint and propel it through a spray gun to the surface being painted. This type of system produces a high-quality finish and can be used with most finishes, including stain, sealer, and topcoat. A disadvantage of air spray as compared with airless spray is the finish is transferred to the surface less efficiently. The large quantity of air mixed with the paint causes paint to be lost through overspray and by bouncing off the surface.

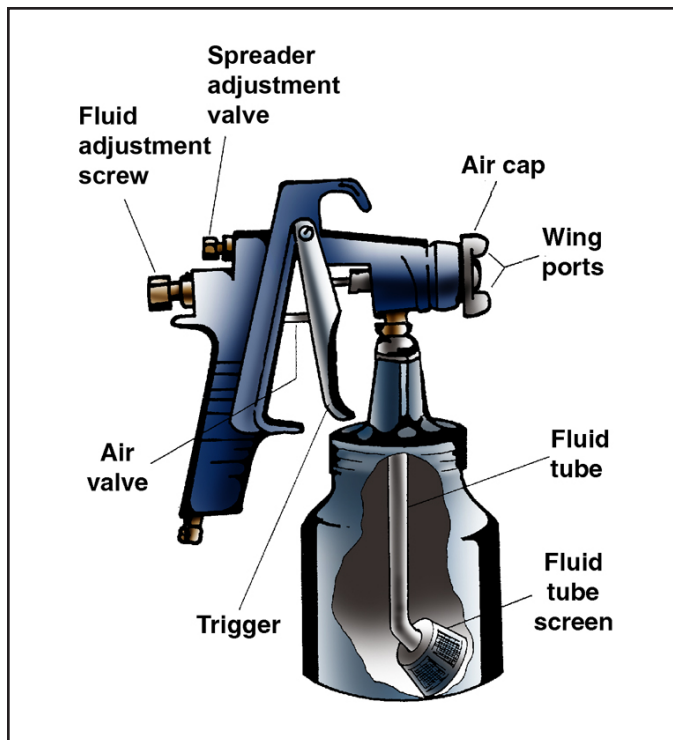
Main parts of a typical spray gun and their functions are as follows. See Figure 7.2.

- **Trigger:** A trigger controls the flow of the liquid or both the liquid and the air depending on the type of gun.
- **Air valve:** Pulling the trigger depresses the air valve and releases air. If the trigger is pulled halfway, only

air flows through the gun. This feature can be used to remove dirt and debris from the surface to be painted. If the trigger is pulled all the way back, finish will also flow through the gun.

- **Fluid adjustment screw:** This screw controls the amount of paint that flows through the gun.
- **Spreader adjustment valve:** This valve sets the shape or pattern of the paint by controlling airflow through the wing ports (see definition below).
- **Air cap:** The air cap directs compressed air into the stream of paint to break it up into the desired spray pattern. Air flows through three sets of holes (ports) in the cap.
- **Wing ports:** These are holes in the wings of the air cap. The amount of air flowing through these holes controls the spray pattern.
- **Fluid tube:** This tube is located in the paint supply and is used to feed the paint up into the gun.
- **Fluid tube screen:** This screen, located at the bottom of the fluid tube, screens out foreign material and lumps to prevent them from entering the gun.

Figure 7.2 – Parts of a Spray Gun



Airless Spray Equipment

Airless spray equipment uses high pressure instead of air to atomize paint. In this system, a fluid pump, powered by electricity or gas, is used to force paint up into the nozzle of the spray gun, where high pressure breaks it up into a fine spray. Advantages of an airless spray system over an air spray system include 1) less overspray because the paint is not mixed with air and 2) faster delivery and heavier coating of the paint because of the high degree of pressure. It is especially useful in covering large surfaces quickly and penetrating porous surfaces such as concrete. A disadvantage is the paint particles are coarser and therefore may produce a lower quality finish.

Preparing Surfaces for Paint

For best adherence, durability, and appearance of the paint, the surface must be properly prepared before it is painted. The type of preparation depends on whether the surface is metal or wood and whether it is new or previously finished.

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Metal

New welds should be cleaned using a chipping hammer and a wire brush. Surface dirt, grease, and rust on metal should be removed with a steam cleaner, high-pressure washer, or approved cleaning solution. Gasoline should not be used because it is too hazardous. Loose paint and rust can be removed from previously finished metal by wire brushing, hand or power sanding, or a combination of both. Pitted areas can be smoothed by these methods as well. The edges of chipped paint can be feathered with sandpaper. Feathering means tapering the uneven areas of a surface until no roughness or edges can be felt. If the paint is badly damaged, the paint can be stripped off to produce a smooth finish for the new paint. The metal is then cleaned with a preparatory solvent, wiped with a cloth, and allowed to dry. Areas that are not to be painted are covered with masking tape. Finally, the surface is coated with an appropriate primer coat, which inhibits rust formation.

Wood

For new wood surfaces, dirt and grease should be removed using approved cleaning solutions. If the wood has surface marks and defects, such as mill marks or dents, these should be sanded or filled as well. Ensure that the wood is dry before sanding and follow the grain of the wood when sanding. Apply a sealer to new wood to prevent moisture from warping or rotting the wood. Ensure that repair defects such as holes are sealed before filling them with caulk or wood filler. Unsealed wood can dry out the filler, causing it to shrink, come loose, and crack the paint. Remove any excess glue from surfaces as well.

With painted surfaces, sometimes only loose paint may need to be removed. However, if the paint is in bad condition, it should be removed using a paint stripper, a wire brush, or sandpaper. Power sanding, such as a wheel mounted on a power drill, can make this process quicker. If a very smooth finish is desired, a thorough sanding is done or a chemical paint remover is used to remove all residue. After the paint is removed, the wood is washed with detergent and water. The wood is sanded if a smooth finish is desired and then dusted off with a tack rag (cloth

that has been chemically treated so that it will pick up dust and grit). The last step in preparing the surface is the application of an appropriate primer coat to seal the wood and improve the durability of the paint.

Choosing Primer and Paint

Applying a primer, an undercoating that prepares the surface for painting, is an essential step in the painting process. Priming a surface before painting has many benefits, including less surface absorption of paint, improving the surface's ability to hold paint, and improving the paint's ability to adhere to the surface. Paints are opaque finishes composed mainly of vehicles (usually oil- or water-based fluids) and pigments (substances that add color and opacity).

A wide variety of primers and paints are available for different surfaces and purposes. Manufacturers' instructions on the product labels provide valuable information about recommended use. When selecting a primer and paint, the following factors should be considered.

- **Intended use:** Think about whether the painted surface will be indoors or outdoors. Paints that are formulated for inside use have the word "interior" on the label and paints formulated for outside use have the word "exterior" on the label. Also think about whether the finish needs to withstand water, acids, solvents, or other agents.
- **Compatibility:** Choose a primer and paint that are compatible with each other and appropriate for the surface.
- **Drying time:** Check the product labels for the drying time of the primer and paint. The drying time needed between applying a primer and a finish coat or between coats of finish can vary greatly. It is also important to consider the temperature when the primer or paint was applied, which can affect the drying time.
- **Type of finish:** Decide which finish is best for the job. Paints are available in various finishes, such as flat, satin, semigloss, and high gloss. These finishes vary in the amount or type of shine, with flat having no shine and high gloss producing the most shine.

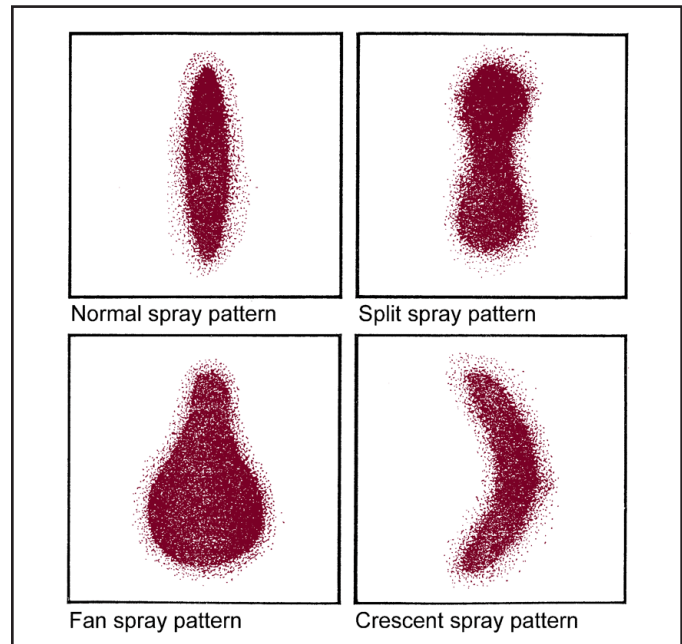
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General Procedures for Using Spray Equipment

Painters must understand and practice the correct procedures and techniques to produce a good finish with spray equipment. The following general procedures should be followed.

- Preparing the work area: Whether spray painting outside or inside in a booth, it is important to remove or protect items in the area so they will not be damaged by overspray. Droplets of paint can float for long distances, settle where they are not wanted, and ruin a finish.
- Preparing the finish: Finishes require thorough mixing by stirring or agitation because the ingredients settle. If multiple cans of the same color are used, mix them together to ensure that all the finish will be the same color. Many finishes are made with a viscosity (tendency to flow) suitable for use with a brush. Such finishes must be thinned with the appropriate thinner so they can be used in spray equipment. Follow the manufacturer's instructions for the correct ratio of finish to thinner. A viscosimeter can be used to determine if the thinned finish is the correct consistency. A viscosimeter is an instrument that measures the rate of flow of a fluid. After mixing and thinning, the finish should be strained to remove any lumps or debris that may clog the spray equipment. Examples of materials used for straining are paper, nylons, and cheesecloth.
- Adjusting the spray gun: The spray equipment should first be set up by following the procedures for safe and correct use. Use a test surface such as a piece of paper, cardboard, or scrap material to determine the spray pattern of the gun. The gun should be held the proper distance from the surface, which is approximately 8 in. for air spray systems. Pull the trigger all the way back and release it. Evaluate the shape of the spray pattern and make any necessary adjustments. See Figure 7.3 for common spray patterns.
 - o Normal spray pattern: This oval-shaped pattern is recommended for best results.
 - o Split spray pattern: This pattern is heavy at the top and bottom and weak in the middle. It is usually caused by the air pressure being too high or by trying to get too wide a spray with thin material. Reduce the air pressure if it is too high.

Figure 7.3 – Spray Patterns



Too wide of a spray can be corrected by opening the fluid adjustment screw slightly and closing the spreader adjustment valve slightly.

- o Fan spray pattern: This top- or bottom-heavy pattern generally indicates that finish is clogging the nozzle and blocking airflow. Cleaning the nozzle and fluid tip with thinner can correct this problem. Do not use metal tools to clean nozzle openings because they can cause damage. Other causes of a fan spray pattern are a loose air nozzle or a bent fluid nozzle or needle tip. Tightening the air nozzle or replacing the fluid nozzle or needle tip can solve these problems.
 - o Crescent spray pattern: This pattern is heavy on one side. It is caused by dried finish blocking airflow through a wing port. Cleaning the port with thinner can correct this problem. Do not use metal tools to clean nozzle openings because they can cause damage.
- Painting a flat surface: The spray gun should be held at a right angle to the surface and at a distance of approximately 8 in. from the surface. Holding the gun steadily at this angle and distance prevents sags and runs or an uneven finish. See Figure 7.4 and Figure 7.5. To begin painting, pull the trigger and move the spray gun parallel to the surface being painted. Moving the

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Figure 7.4 – Correct and Incorrect Angles for Holding the Spray Gun

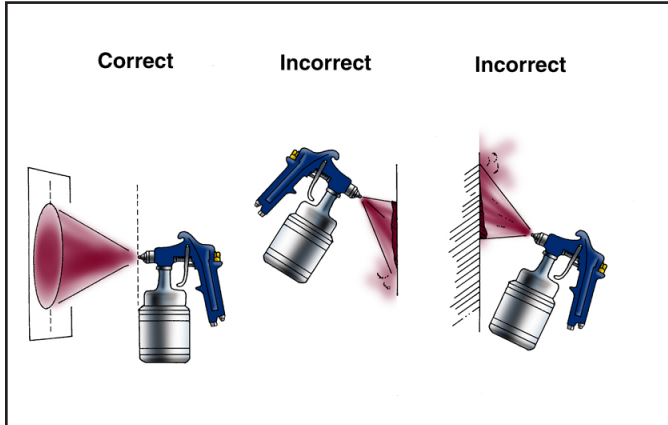
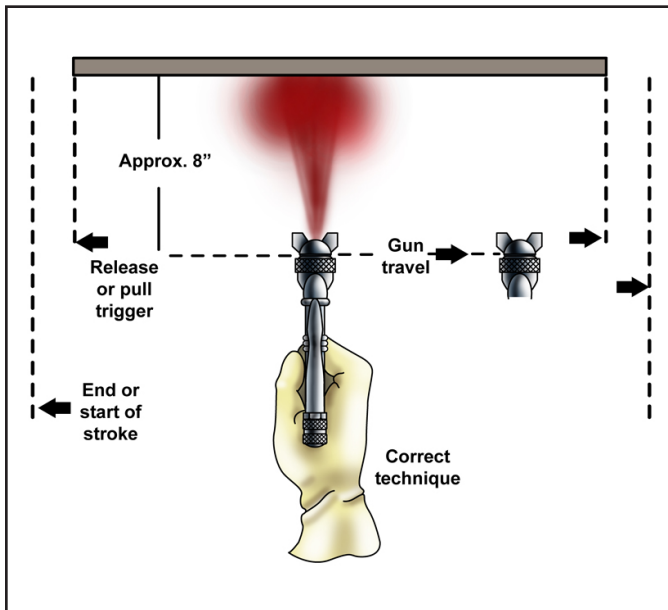


Figure 7.5 – Technique for Moving the Spray Gun

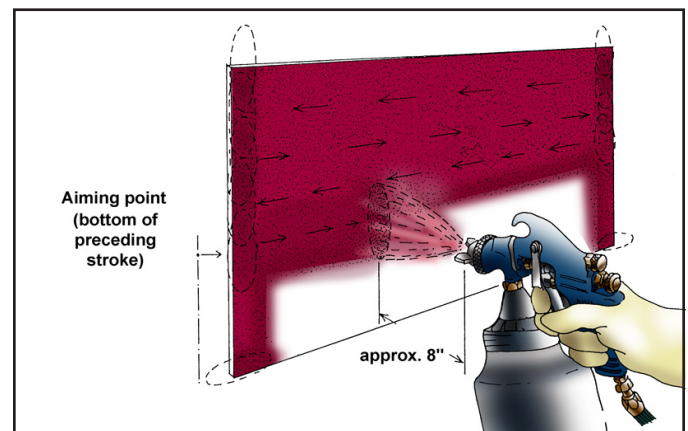


gun in an arcing motion rather than parallel produces an uneven finish. There will be thin spots at the points where the gun is farther away from the work and thick spots where it is close to the surface. The following are guidelines for spray painting a large, flat surface such as a panel.

- o Paint difficult-to-cover areas, such as edges and corners, first. To paint the edges of the panel, turn the wing ports so the spray pattern is horizontal and make one pass from top to bottom on each edge.

- o After the edges are painted, turn the wing ports back to the vertical position and start the first pass at the top left of the panel. Be sure that the middle of the spray pattern is at the top edge of the panel. Each pass should start and end at a point 2 to 3 in. outside the panel. While the gun is in motion, pull the trigger and move across the panel at a constant rate of speed. Release the trigger while the gun is still moving. Starting and stopping the paint flow while the gun is in motion prevents an excessive buildup of paint where passes overlap. To make the second pass, aim the gun so that the middle of the spray pattern is at the bottom of the spray pattern from the previous pass. The pass should overlap the previous pass by about 50%. Continue making alternating left and right passes using the same technique until the panel is completed. See Figure 7.6.

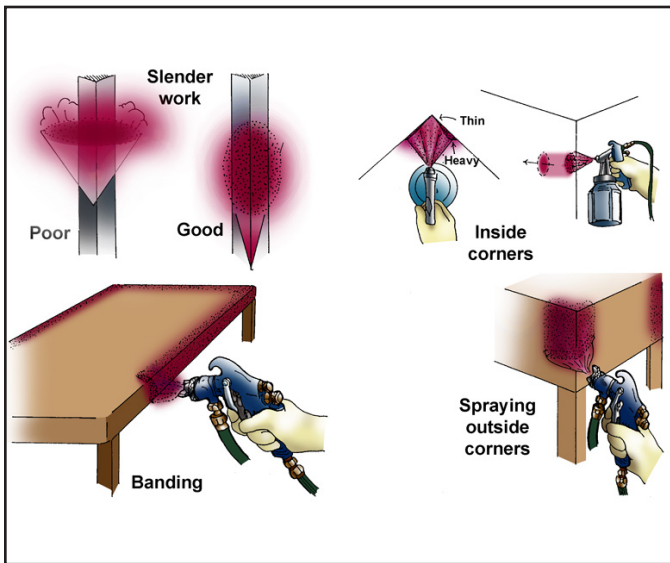
Figure 7.6 – Movement of Spray Gun for Each Pass, With Each Pass Overlapping the Previous Pass



- Painting other surfaces: Surfaces other than flat are more difficult to paint, so special techniques are used on these surfaces. See Figure 7.7. When spray painting thin, vertical pieces such as chair legs, it is more efficient to adjust the wing ports for a vertical spray pattern. Corners, such as those in a room, should be painted as though they were two separate panels. Spraying directly into the corner causes excessive paint buildup in the corner. To paint outside corners, use a horizontal spray pattern and aim the gun so that the middle of the spray pattern is at the edge

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Figure 7.7 – Special Spray-Painting Techniques



of the corner. Use a vertical spray pattern to paint narrow edges, such as the edge of a tabletop. This technique is called banding.

- **Cleaning the spray gun:** Spray equipment must be cleaned thoroughly after every use to ensure it will operate properly for the next painting job. It is important to follow the manufacturer's recommendations and instructor's directions for the correct cleaning procedure for the equipment used. General guidelines include emptying the paint cup into an appropriate container that is labeled and can be tightly sealed. If the finish is not going to be saved, it should be discarded properly. A cleaning solution, which is designed for the type of finish used, is then run through the gun to remove the finishing material. The air cap is also cleaned with the solution. Metal tools should not be used to clean spray gun openings because they can cause damage. All parts of the spray gun are dried and the gun is reassembled. If the sprayer has been used to spray water-based material such as latex paint, mineral spirits should be run through the gun to remove any moisture and keep the gun from rusting. After the cleaning process is complete, all cleaning materials should be disposed of safely and properly and all materials and equipment should be returned to their proper places.

Common Spray-Painting Defects

When paint fails, it is a waste of time, money, and effort. The object is not protected and the work must be done again. Painters in agricultural mechanics should be able to recognize common spray-painting defects and make adjustments in technique, finish preparation, and equipment settings to prevent these problems. Common spray-painting defects are as follows:

- **Runs and sags**
 - Possible causes of this defect include applying finish too heavily, holding the spray gun too close to the surface, using finish that is too thin, setting the fluid pressure too high, and moving the gun too slowly.
 - Ways to correct this defect include learning to calculate the depth of wet finish, holding the spray gun farther from work, adding enough finish to thicken it to the correct viscosity, using the fluid control knob to reduce fluid pressure, and increasing the speed of operation.
- **Streaks**
 - Possible causes of this defect include holding the spray gun too far from the surface, not overlapping passes properly, setting the air pressure too high, and moving the spray gun too quickly.
 - Ways to correct this defect include holding the gun closer to the surface, overlapping the previous pass more accurately, reducing the air pressure, and decreasing speed of operation.
- **Orange peel**
 - Possible causes of this defect include not using enough thinner, allowing overspray to strike a tacky finish, and operating at pressures that are too high or too low.
 - Ways to correct this defect include adding enough thinner to produce the correct viscosity, adjusting the spraying sequence or procedure, and adjusting pressure as needed.
- **Rust under the finish**
 - A possible cause of this defect is not preparing the surface properly for the finish.
 - This defect can be corrected by removing the finish and the rust, coating the surface with the appropriate primer, and reapplying the finish.

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Summary

Spray painting is a fast and efficient way to apply a protective coating on a surface. Safety must be the first consideration when working with finishing materials and using spray-painting equipment. The two common types of spray equipment used in agricultural mechanics are air and airless spray equipment. Achieving good paint adherence, durability, and appearance depends on several factors: properly preparing the surface, choosing the correct primer and paint, operating spray equipment properly, and making adjustments to prevent paint failures.

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