Refinishing Equipment (REF01e)

Textbook

Version 4.3

REF01e-STMAN1-E

This page is intentionally left blank.

Contents

This page is intentionally left blank.

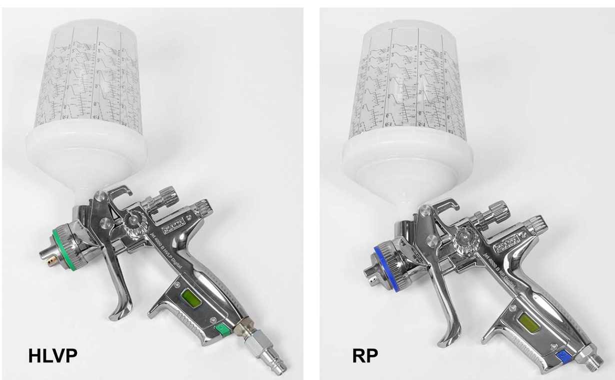
Module 1 - Spray Guns

This page is intentionally left blank.

Spray Guns

Learning objectives for this module include:

- describing the various types, designs, and parts of a spray gun.
- explaining the importance of cleaning and maintaining a spray gun.
- describing how to set up a high volume low pressure (HVLP) spray gun.



Gravity feed spray guns are common types of tools used for refinishing.

Spray guns used for refinishing may be different designs. Some of these are:

- high pressure (HP). An HP spray gun uses high pressure, low volume air. The inlet air pressures for an HP range from 70 to 90 pounds per square inch (psi). This type of spray gun may also be referred to as conventional. HP spray guns are considered old technology.
- high volume low pressure (HVLP). An HVLP spray gun operates by high volume and low pressure of air passing through the spray gun. The inlet air pressure is about 45 psi with an air cap pressure of 10 psi or less.
- reduced pressure (RP). An RP spray gun uses a reduced inlet pressure of 32 psi that allows optimized high pressure to acheive transfer efficiency above 65%, even though the gun does not have 10 psi or less at the air cap. This type of spray gun is primarily used for high solid clearcoats, as it aids in the atomization and evaporation of solvents and reducers to allow for an improved transfer of material.

Low volume low pressure (LVLP) spray guns have limited use and availability.

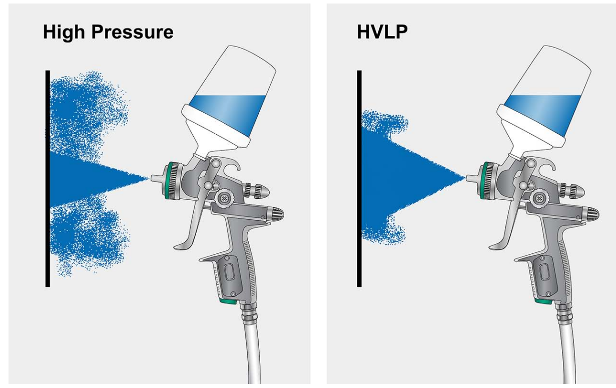
The amount of air pressure that is produced by an air compressor is measured in psi. Cubic feet per minute (cfm) is the volume of air delivered that is required for a tool to operate properly. Smaller air compressors may not be able to produce the high air volume required for HVLP spray guns. Most air tools used in a repair facility require less cfm than the tools used for refinishing. An example of this is the Dynalocke dual-action (DA) sander which requires 3 cfm, whereas an HVLP spray gun is upwards of 25 cfm.

Shown are HVLP gravity (left) and siphon (right) feed spray guns.

Spray guns may be:

- gravity feed. Gravity feed spray guns operate by the paint cup being located above the spray gun body. Fluid will flow out of a gravity feed spray gun when there is no air pressure and the trigger is pulled. This is because material moves through the spray gun by gravitational force and not vacuum.
- siphon feed. A siphon feed spray gun has the paint cup located below the spray gun body. The material is drawn out of the spray gun by vacuum created by the air cap. Atmospheric pressure inside the paint cup forces the material up through the spray gun body and out of the fluid needle.

Pressure feed spray guns, though common at one time in the industry for spraying refinish materials, are now typically used to apply chip-resistant coatings and corrosion protection materials. A pressure feed spray gun operates by pressurizing the cup which aides in allowing higher viscosity materials to be atomized.



HVLP allows for more control of the refinish material, which aides in transfer efficiency.

Transfer efficiency is the amount of material a spray gun can deposit on a surface. The material that is not on the intended surface is considered overspray.

An advantage of using an HVLP is that the use of lower pressures allows for more control of the material being sprayed. The transfer efficiency of an HVLP spray gun is typically 65% or better. This can be affected by many variables, including spray technique. Several ways to increase transfer efficiency are to use:

- the recommended spray gun setup for fluid needle, fluid nozzle and air cap selection.
- a smaller spray pattern. This keeps the refinish material focused on the panel.

Parts of a spray gun that may require frequent cleaning and adjustment include the:

1. air cap, which is located on the top of the spray gun. The air ports on the air cap direct airflow past the fluid nozzle. As the air passes by the fluid nozzle, a vacuum is created and the paint also gets atomized.
2. fluid nozzle, which is matched to the fluid needle and must be kept in sets.
3. fluid needle, which moves in and out of the spray gun and can be adjusted to regulate the amount of fluid delivered.
4. spray gun body, which houses, or has attached to it, all of the parts that make up a spray gun. Spray gun bodies also have within them all of the air and fluid passages.
5. trigger, which is the control for the fluid needle valve and air valve.
6. paint cup, which may be located in a variety of positions. Depending on the type of spray gun being used the paint cup could be located above, below, or attached by a hose.
7. fluid control knob. Adjusting the fluid control on a spray gun changes the amount of fluid that is released out of the spray gun. The spray pattern can be adjusted from a light dusting to a deposit rate that will cause runs.
8. fan adjustment knob, which is used to change the spray pattern of the spray gun. The spray pattern can be adjusted from a small circle to an oblong spray pattern.

Refer to the "Animation: Gravity Feed Spray Gun" in the presentation. This animation shows how refinish material and compressed air flow through a spray gun.

Shown are the three different air passages within the air cap.

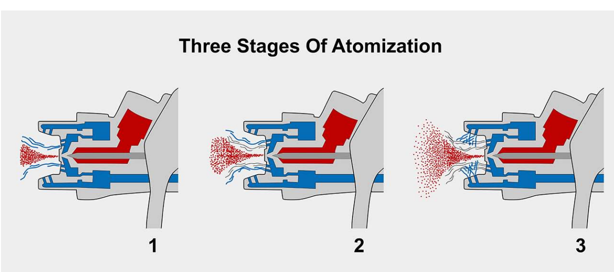
Shown are several different types of air caps.

An air cap has passages that direct air past the fluid needle. These passages are the:

- center hole.
- auxiliary holes.
- air horn holes.

The type of air cap may also affect the amount of:

- fluid flow through the spray gun.
- air pressure needed.



The full atomization of refinish material occurs in three stages.

These passages within the air cap help achieve full atomization in three stages. During the:

- first stage, a rush of air from the center hole creates a vacuum at the fluid tip. As air is directed across the fluid passages, a pressure difference occurs. This is due to the creation of a venturi or vacuum. The refinish material is pulled in by the vacuum and air turbulence starts to break up the refinish material.
- second stage, partially atomized refinish material is hit by an air stream from the auxiliary holes and the refinish material is further atomized.
- third stage, air from the air horn holes hits the atomized refinish material and causes it to form the spray pattern.

Shown is a fluid needle.

The fluid needle is:

- opened and closed by the trigger.
- used to control the amount of fluid into the air stream. The opening between the nozzle seat and tip of the fluid needle valve determines

the amount of fluid that can flow through.

The fluid nozzle provides airflow to the the air cap and helps meter fluid.

The fluid nozzle:

- works with the fluid needle value to meter fluid into the air stream.
- forms an internal seat for the fluid needle valve to shut off the fluid flow.
- has openings. The size of the openings determines the maximum amount of fluid that can be delivered.
- provides airflow to the air cap.

Fluid needles and nozzles come matched.

The fluid needle and fluid nozzles are matched to the spray gun and the material being sprayed. They cannot be interchanged with other needles and nozzles. Fluid needles and nozzles may be numerically identified. The larger the number, the larger the orifices. Larger numbers and diameter orifices are used to spray higher viscosity materials.

The body of the spray gun connects the paint cup and houses many of the working parts.

The body of the spray gun houses, or has attached to it, all the parts that make up a spray gun. Spray gun bodies also have within them all of the air passages and fluid passages.

Spray guns bodies are commonly made of aluminum.

HVLP spray guns have larger air passages machined through the spray gun body. This is to accommodate higher volumes of compressed air.

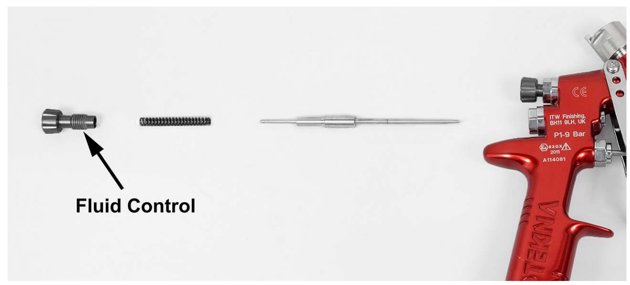
The spray gun trigger opens and closes the air valve and fluid valve.

The spray gun trigger has two steps. With the triggering of the first step, the air valves are opened, filling the chambers with compressed air. The second triggering pulls the fluid needle off of its seat which allows the refinish material to flow into the spray gun body.

Shown is a disposable plastic paint cup with a built-in strainer.

The paint cup:

- is mounted to the spray gun body.
- may be a disposable plastic with a built-in strainer. Most strainers for waterborne finishes are recommended to be 125 - 200 microns. Refer to the paint maker's technical data sheet to verify the correct strainer type to use.
- may be metal, though it is recommended to use a coated or plastic paint cup with certain materials, such as etching primers and waterborne products, as they may cause damage to uncoated metal paint cups. Some refinish materials should not be left in a paint cup for extended periods of time.

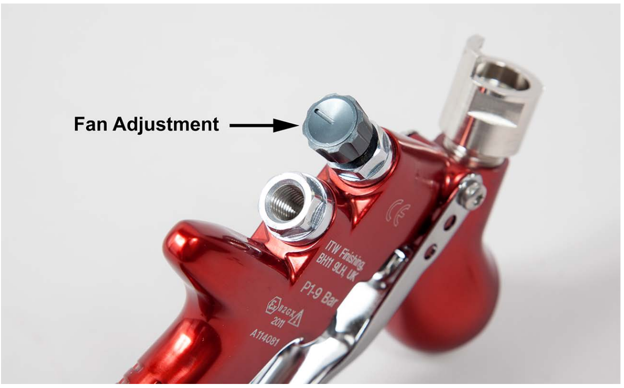


The fluid control is used to adjust the amount of material and atomization.

The fluid control adjustment affects two basic functions. The fluid control can be:

- adjusted to change the amount of material released from the spray gun.
- used to adjust the atomization of the fluid exiting the spray gun.

The fluid control is located at the rear of a spray gun. The adjustment of the fluid control needs to be made before the refinish technician begins applying any type of material. A fluid control set too light will cause poor hiding, and an adjustment that is too heavy may cause runs.



The fan adjustment can be located in different areas depending on the spray gun maker.

Another important adjustment of the spray gun is the fan adjustment. The fan adjustment is used to control the size of the spray pattern. The fan adjustment can be adjusted to produce a spray pattern that is a small diameter circle or a long oblong pattern.

Along with changing the physical spray pattern, the fan adjustment can also affect the atomization of the material being sprayed.

Cleaning And Maintenance

Spray gun washers are used to evacuate solvent fumes and contain cleaning solvent.

Whether using solvent-borne or waterborne refinish materials, always clean the spray gun immediately after use with the paint maker's recommended solution. This will help ensure that the spray gun continues to operate properly and contaminants are not transferred to other refinishing jobs.

Items to keep in mind when it comes to cleaning a spray gun include:

- do not immerse and soak in a bath of solvent. Allowing a spray gun to be soaked in solvent will cause excessive stripping of needed lubrication.
- using compressed air to dry the inside and outside of a spray gun that has been cleaned of waterborne materials.

A spray gun washer is a unique cleaning tool for the refinish technician. Spray gun washers use air-agitated solvent, whether it be for waterborne or solvent-borne refinish materials, to clean the guns. An enclosed spray gun washer operates similar to a dishwasher. Spray gun washers:

- are fire rated.
- must be grounded to avoid sparks.
- are generally pneumatically operated.
- must be assembled and used according to local building and fire codes.

Spray gun washer cleaning solvent is regulated by local volatile organic compound (VOC) regulations.

Refer to Video: Cleaning A Spray Gun in the presentation. This video discusses cleaning a spray gun.

Spray gun specific lubricant is needed to properly maintain a spray gun.

When maintaining a spray gun, lubrication of moving parts will be necessary on a regular basis to help minimize wear and prolong the life of the spray gun. When lubricating a spray gun, use a lubricant that:

- is designed to be used on spray guns.
- is compatible with refinish materials.
- will not contaminate the spray gun.

Do not use conventional oil such as engine oil, transmission fluid, WD-40, spray or liquid silicone, Liquid Wrench, or air tool oil as these will cause defects in the refinish materials.

The refinish technician will also need to be able to identify:

- what parts wear out, and how often they need replacement.
- what parts are available for the specific spray gun used.
- if the spray gun needs to be returned to the manufacturer for repair.
- if a rebuild kit is available, and what parts are included in the kit.

Refer to Video: Rebuilding A Spray Gun - Part 1 in the presentation. This video discusses rebuilding a spray gun.

Refer to Video: Rebuilding A Spray Gun - Part 2 in the presentation. This video discusses rebuilding a spray gun.

HVLP Spray Gun Setup

Special gauges aid in the proper spray gun setup.

When setting up an HVLP spray gun:

- adjust the inlet pressure. The spray gun maker will recommend a specific inlet pressure at the base of the spray gun.
- measure the air cap pressure and adjust as necessary for proper airflow. Too much or too little airflow can cause problems when applying material.
- a special gauge / cap can be used for monitoring air pressure at the air cap. There are two gauges on some air pressure caps. These gauges measure air pressure at the air cap ear and near the fluid nozzle.

Check the material or spray gun maker's setup charts for the proper fluid needle and nozzle. Below are links to several gun maker's setup charts:

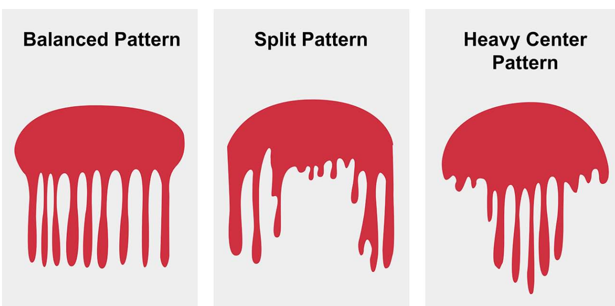
- Anest Iwata
- DeVilbiss
- Sata USA

Shown is a SATA air regulator.

When adjusting air pressure at the inlet of the spray gun, keep in mind that:

- spray gun makers will state a specific inlet pressure at the base of the spray gun.
- the proper inlet air pressure will give 10 psi at the air cap with the fan control wide open.
- as the fan control is closed, the air cap pressure increases.
- air regulators adjust the air supply to pressures required by the spray

gun maker and for other power tools. Begin adjusting the air pressure at the wall regulator and allow for pressure drops if long air hoses are being used. An air regulator on the spray gun should be used to make minor adjustments only. Ultimately, the pressure valve at the spray gun should be used to measure inlet pressure. An air regulator maintains a constant air pressure and air volume. A cheater valve restricts airflow and creates an unstable air pressure and air volume. Cheater valves should not be used with spray equipment.



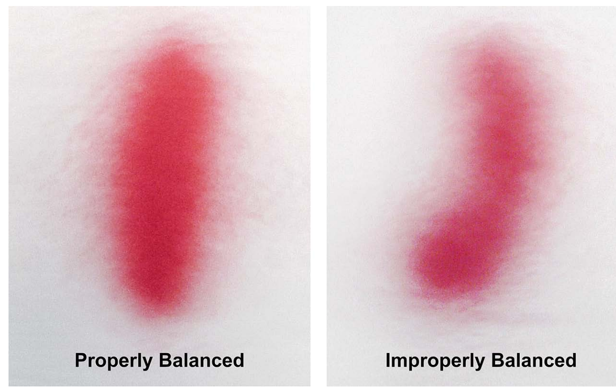
Air pressure is set properly adjusted (left), too high (center), and not enough air (right).

When testing for fluid distribution:

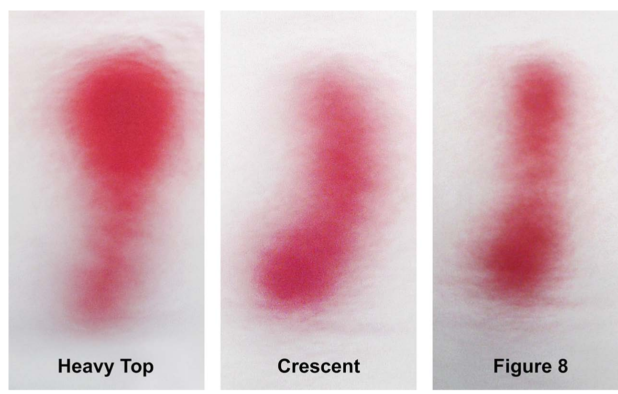
- rotate the air cap so that the air horns, or ears, are straight up and down. This will produce a horizontal spray pattern.
- hold the spray gun 8 - 10" from the surface.
- pull the trigger until the refinish material begins to run.
- the runs will be about the same length if all adjustments are correct.

If the sides sag more, the air pressure is too high or the fan adjustment knob is set too wide.

If the center sags more, there is not enough pattern air. Either turn out the fan adjustment knob, turn in the fluid control knob, or increase the air pressure.



A spray pattern needs to be uniform and equal.



Shown are several spray pattern problems.

To perform a quality refinish, the spray pattern needs to be uniform and equal. If the pattern is not uniform with the amount of material that is deposited, the finish will have a poor appearance.

A balanced spray pattern has an equal amount of material deposited in the spray pattern.

Improper patterns will show heavy or light spots in the pattern. A pattern that is depositing heavy on the top or the bottom indicates that material has dried around the outside of the air cap. The air cap will need to be removed, cleaned, and a new test pattern sprayed. Two other types of spray pattern problems are a:

- crescent-shaped patterns, caused by a restricted air passage in the air cap horn.
- figure 8 patterns, caused by atomizing air pressure that is too high for the viscosity of the material being sprayed.

Module Wrap Up

Topics discussed in this module included:

- the various types, designs, and parts of a spray gun.
- the importance of cleaning and maintaining a spray gun.
- how to set up a high volume lower pressure (HVLP) spray gun.

This page is intentionally left blank.

Module 2 - Compressed Air

I-CAR®

This page is intentionally left blank.

Air Requirements

Learning objectives for this module include:

- explaining the type of compressed air that is required for refinishing.
- describing how to use compressed air.

The proper size and type of air compressor is necessary for providing quality compressed air.

Compressed air for refinishing needs to be of a higher quality than that used for ordinary air tools.

Compressed air must be clean and dry and not contain any contaminants, such as water or oil vapor.

Compressed air filters may look different depending on the function they perform.

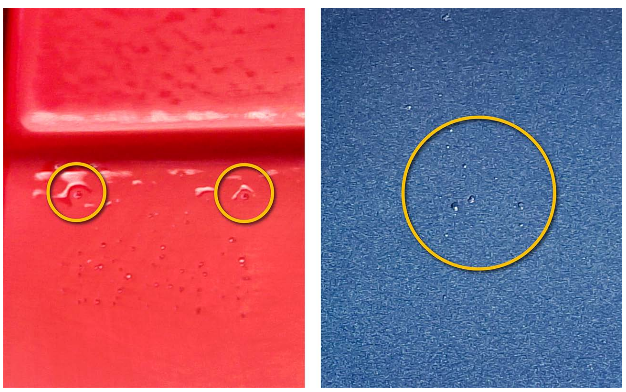
To maintain quality compressed air at the spraybooth, the:

- filters at or near the spraybooth must be purged or inspected on a regular basis.
- accumulation of contaminants must be removed. Failure to maintain the filters can lead to paint defects.

Filters and desiccant material may be used alongside each other.

Air line filters are compressed air filters that are placed inline of the main air supply. They are designed to collect and remove contaminants from the air supply, such as debris, water, and oil. Examples of air line filters include:

- filtered centrifugal separators, which remove bulk liquids from the compressed air.
- coalescing oil removal filters, which remove oil aerosols contained within the fresh air breathing system.
- oil vapor adsorbing filters, which remove oil vapors and oil that are in the gaseous state. This is accomplished through two layers of activated charcoal.



Fisheyes are caused by oil and / or water in the compressed spraying air.

Contaminated compressed spraying air may cause refinish material to not adhere to a surface and, depending on the type of contamination, fisheyes may occur.

When applying a finish to a surface there needs to be complete and solid adhesion. Failure to attain proper adhesion may result in small to large sections of refinish material lifting or easily being removed from the surface.

Using Compressed Air

Connect air hose inlets to regulators and shutoff valves inside the spraybooth.

Variables that may lead to pressure drops include:

- hose length.
- the type of regulators used.
- the size of quick-disconnects in the air lines.
- using hoses less than 3/8" inside diameter.

Keep hoses clean. This will help air hoses last longer and reduce contamination in the finish.

Never use an air hose for fresh air breathing that is not designed for that specific use.

When working in the spraybooth or in the repair area of the facility, there should be separate air hoses used for each area. The air hoses used in the spraybooth should not be used in the shop, and breathing air hoses should have different style quick-disconnects so they can only attach to the breathing apparatus.

Fresh air breathing hoods offer the most protection to the face, head, and neck.

While working in a spray environment or with materials that produce hazardous vapors, the use of compressed air breathing equipment may be required. There are two common types of compressed air breathing equipment. They are:

- fresh air masks, which allow fresh air to be breathed and offer no protection to the facial skin.
- fresh air hoods, which allow fresh air to be breathed and offer complete protection to the facial skin.

Grade D breathing air has requirements that must be met and maintained. An audible alarm must be heard in the spraybooth. Several requirements for grade D breathing air include:

- no oil vapors.
- less than 10 parts per million (ppm) of carbon monoxide (CO).
- less than 1,000 ppm of carbon dioxide (CO_2).

Module Wrap Up

Topics discussed in this module included:

- the type of compressed air that is required for refinishing
- how to use compressed air.

This page is intentionally left blank.

Module 3 - Spray Environment

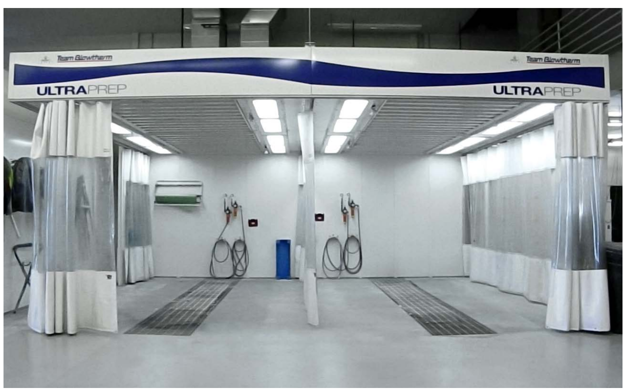
I-CAR®

This page is intentionally left blank.

Spray Stations

Learning objectives for this module include:

- describing the types of spraybooths currently in use.
- identifying the various adjustments that can be made within a spraybooth.
- explaining the different controls and settings of a spraybooth.
- explaining how to maintain a spraybooth.



The prep deck may be used for sanding or spraying a limited amount of material.

Prep decks may appear similar in appearance to that of a spraybooth. The difference being is that a prep deck typically has curtains and not solid walls. Prep decks may:

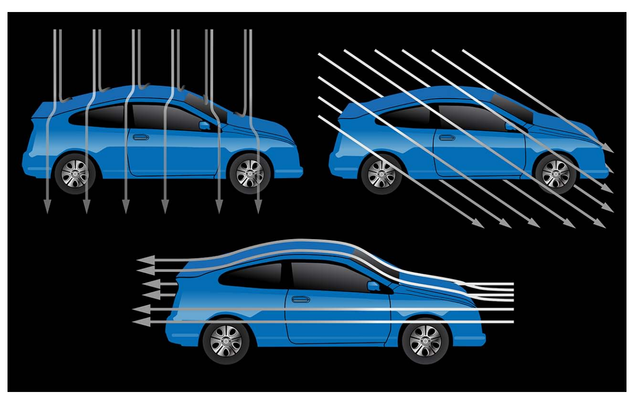
- be used as a sanding station.
- allow refinish materials to be applied.
- be heated.
- be used for edging parts.
- be regulated by local rules.

Some local or national fire codes may regulate the types of duties that may be performed inside a prep deck.

A spraybooth should be clean, bright, and airtight.

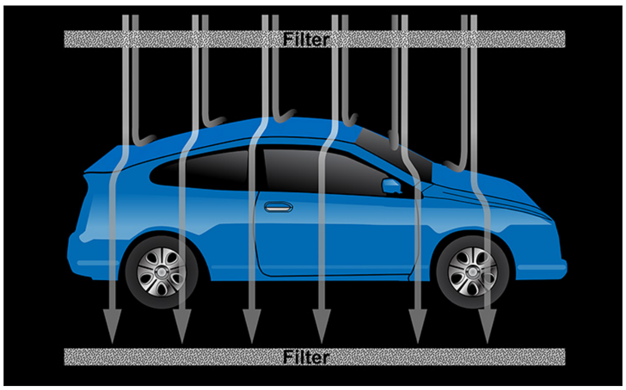
A spraybooth provides:

- a clean spray environment.
- the ability to control the temperatures for spraying and baking.
- limited exposure to hazardous chemicals.
- fire protection.
- color-corrected lighting for color matching.


Shown are the three different types of spraybooths; downdraft (top left), semi-downdraft (top right), and crossdraft (bottom).

The three most popular types of spraybooths in use are:

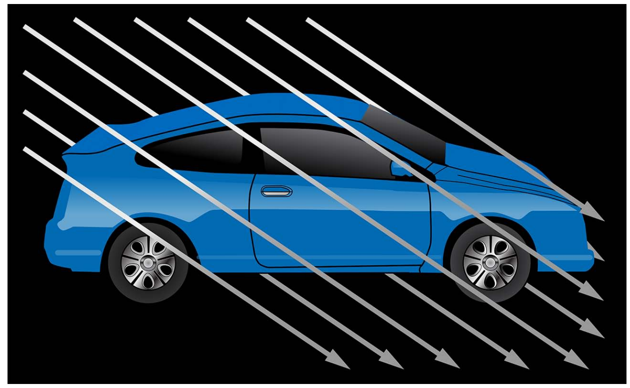
- downdraft.
- semi-downdraft.
- crossdraft.



Air flows this direction in a downdraft spraybooth.

A downdraft spraybooth:

- is designed to control overspray removal and dust more effectively when compared to other types of spraybooths available today.
- operates by drawing air in from the ceiling and out through the floor.
- may have the ability to recirculate heated air. Recirculating heated air allows greater efficiency of the heating system.


Air flows diagonally in a semi-downdraft spraybooth.

A semi-downdraft spraybooth:

- draws air into the spraybooth from vents above the doors and evacuates the air through the rear of the spraybooth.
- allows for control of dust. In the event that there is any debris in the spraybooth, instead of it being drawn from the roof of the vehicle to the floor, the debris is moved across the length of the vehicle. This allows more surface area for the debris to contact.

Air flows this direction in a crossdraft spraybooth.

A crossdraft spraybooth:

- draws air into the spraybooth from filters in the doors and evacuates the air through filters in the rear corners of the spraybooth.
- allows for control of dust. In the event that there is any debris in the spraybooth, the debris is moved across the length of the vehicle. This allows greater surface area for the debris to contact.

  The crossdraft spraybooth directs most of its airflow along the sides of the vehicle. This is because the exhaust filters are primarily located at the rear corners of the spraybooth.

Spraybooth Adjustments

The internal spraybooth temperature can be adjusted at the control panel.

Spraybooths have a variety of adjustments that can be performed. These adjustments can include:

- setting to a specific temperature.
- air pressure. This may include increasing or decreasing the amount of air entering and exiting the spraybooth.
- adjustment to one specific temperature and pressure setting for a specific type of material.

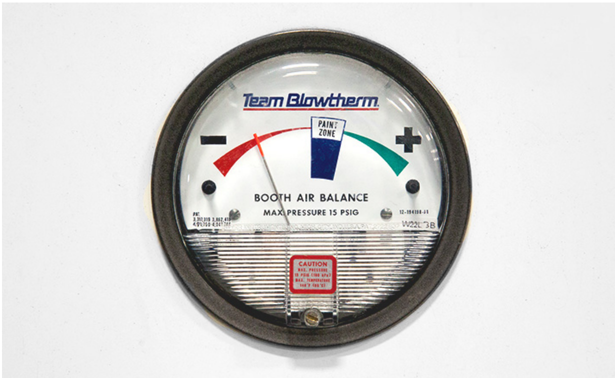
The amount of airflow through the spraybooth can affect the outcome of the refinish.

To properly test the amount of air flowing through a spraybooth, the use of a Magnahelic or a manometer is required. The function of a Magnahelic is to measure the pressure or vacuum in a spraybooth.

Too much pressure in the spraybooth is called “positive pressure.” This occurs when more air is entering the spraybooth than is exiting.

Too much vacuum in the spraybooth is called “negative pressure.” This occurs when more air is exiting the spraybooth than is entering.

Prep decks, like spraybooths, may be able to be balanced by watching the curtains. Too much pressure causes the curtains to push out. Too little pressure causes the curtains to draw into the prep deck.



Too little airflow may cause poor material transfer.

Setting the spraybooth to create a vacuum or negative pressure may cause:

- a vacuum within the spraybooth.
- dirt to be drawn in from outside the spraybooth.
- improper material transfer.

Spraybooth pressure is monitored with the use of a Magnahelic or manometer.

Too much incoming airflow will not evacuate dust and overspray.

Positive pressure occurs when more air is entering the spraybooth than is exiting. Setting the spraybooth to create a positive pressure may cause:

- the spraybooth to become pressurized and force refinish material into the shop environment.
- dirt to be held outside of the spraybooth. This happens by air pressure seeping past and through seals and gaskets.
- overspray to not be removed from the spraybooth. This is caused by insufficient exiting airflow.

Dirty filters will restrict airflow.

Restricted airflow or movement through a spraybooth may indicate that:

- there are dirty, restricted filters.
- the spraybooth baffles are not functioning properly.
- refinishing is performed in one area of the spraybooth.

Spraybooth filters should be replaced on a regular schedule.

Spraybooth filters require replacement at various intervals depending on the amount of hours the spraybooth filters have been exposed to paint and debris. The replacement of spraybooth filters are important because:

- a spraybooth should not be balanced until after the filters have been replaced.
- clean spraybooth filters aid in producing a quality refinish.
- in some geographical areas the buildup of debris may be considered a hazardous material and may require special disposal of the used filters.

All spraybooth filters should be checked for replacement on a regular basis.

There are a variety of filters used in a downdraft spraybooth, including the:

- intake filters.
- pre-filters.
- ceiling filters.
- in-floor filters.
- recirculation filters.

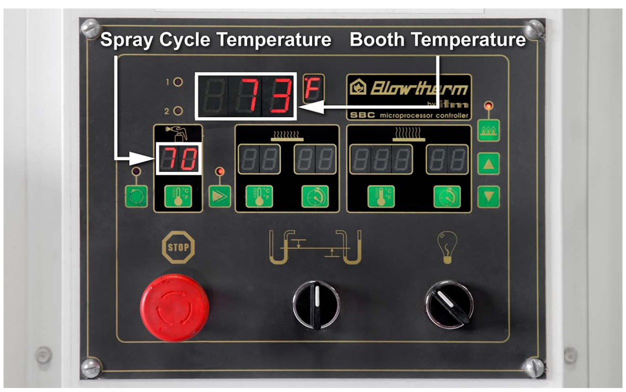
Controls And Settings Of A Spraybooth

Spraybooth temperature can be adjusted to match refinish material requirements.

The three main cycles of a spraybooth include the:

- spray cycle, which controls the spraybooth conditions while the technician is applying refinish materials.
- purge cycle, which evacuates excess overspray and debris from the spraybooth before baking.
- bake cycle, which aids in the drying and curing of the refinish material.

These cycles may be on a control panel that has to be reset every time a change occurs, or they may be able to be preprogrammed into the spraybooth control center for different types of materials.



The spraybooth temperature is displayed during the spray cycle.

The spray cycle allows the refinish technician to adjust and maintain proper spraybooth temperatures. With the ability to manipulate the temperature at each stage a refinish material is applied, the refinish technician should be able to attain top quality results.

The spraybooth temperature and time left is displayed during the purge cycle.

The purge cycle allows the refinish technician time between the spray cycle and the bake cycle to evacuate solvents, moisture, debris, and other contaminants within the spraybooth. With the ability to manipulate this environment, the refinish technician should be able to attain top quality results.

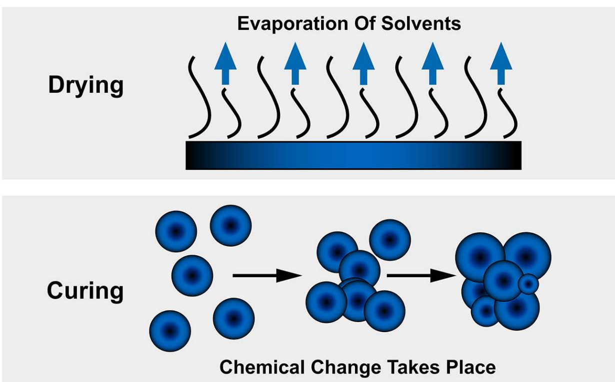
The spraybooth temperature and time left is displayed during the bake cycle.

The bake cycle, which follows the purge cycle, allows the refinish technician to accelerate the drying time of refinish materials.

Although the refinish technician has the ability to dry and cure refinish materials faster than just air drying, the technician still needs to realize that there are variables that can cause poor results if the paint maker's guidelines are not followed.

Vehicle Protection

Vehicles that use compressed natural gas should have the tanks removed before the vehicle is moved into a spraybooth.



Illustrated is what occurs during the drying and curing process.

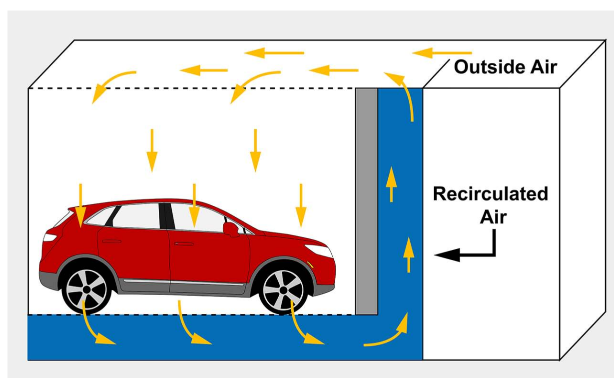
After refinish materials are applied, there are two processes that occur. There is the state of:

- drying when the evaporation of solvents and liquids are removed from the material.
- curing when a chemical change occurs within the refinish material.

Surface temperature can be measured using a noncontact surface thermometer.

Available surface temperature thermometers include:

- magnetic and paper thermometers, which can be placed near the area being heated.
- noncontact type thermometers, which can be used from a distance.



Some spraybooths recirculate heated air.

Spraybooth burner efficiency has to do with the design of the spraybooth and the ability to recirculate heated air. Some spraybooths are designed to recirculate the heated air during the bake cycle. This keeps the burners from being overworked. A spraybooth that is designed to constantly heat the outside air without reclaiming any of the heated air causes inefficient heating.

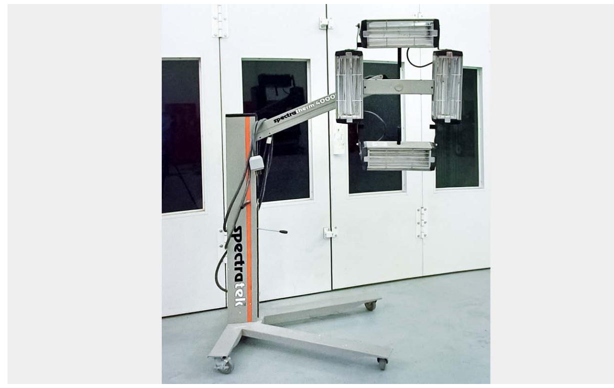
Shown is a portable infrared lamp (top left), hand held mulitpliers (bottom left), and venturi blowers (right).

When drying or curing the applied finish, there are both portable and permanent drying and curing tools. Portable tools include:

- infrared (IR) heaters, which use a type of lamp to create the heating effect.
- hand held multipliers, used with waterborne materials.

Permanent drying and curing tools may be:

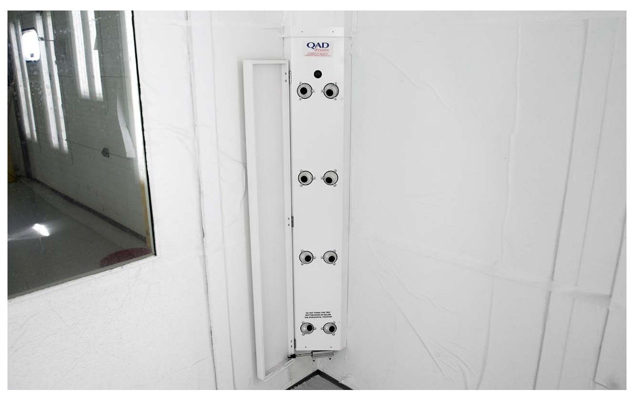
- venturi blowers, also mounted on the spraybooth walls.
- convection heat, which is heated air forced from the ceiling to the floor.



A portable IR heating unit can be moved around the shop for convenience.

Permanent and portable IR heating units operate by using short and medium wave lengths from the light spectrum.

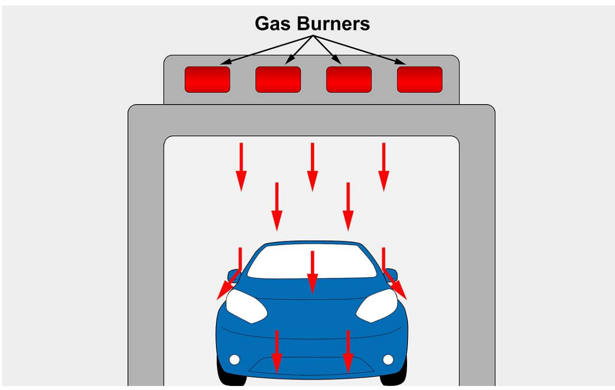
These waves travel through the air heating only the solid object they contact. As the wavelengths penetrate the refnished surface, the entire film thickness is heated, thus aiding in the release of solvents and drying of the material.



Venturi blowers are used to remove water from waterborne materials.

Unheated spraybooth air is blown through small venturi-style blowers. This type of blower:

- directs air across the refinished surface.
- may be portable or permanently mounted in the spraybooth.
- is used to remove the moisture from waterborne materials.



Spraybooth burners are located on the air intake side of the spraybooth.

The convection heating system operates similar to an oven. There are burners located on the air intake of the spraybooth. Before the air enters the spraybooth, it is heated by the burners, and the warm air is directed across the vehicle.

Spraybooth Maintenance

Shown are spraybooth walls that have spraybooth wrap applied.

To ensure that a quality refinish is obtained, there are certain spraybooth cleaning procedures that need to be performed on a regular basis. These procedures include:

- vacuuming the spraybooth floor.
- sandblasting the floor grates to remove excessive overspray.
- wiping down the door seals to prevent dirt from getting into the spraybooth.
- wiping down the walls to keep them white and free of debris.
- applying spraybooth masking to the walls of the spraybooth. This will help eliminate overspray from sticking to the spraybooth walls.
- applying spraybooth wrap, referred to as Dirt Trap by 3M, to the walls and floor of the spraybooth. This improves the refinish quality by trapping airborne contaminants.

Refer to "Video: Booth Wrap - 3M Dirt Trap Installation" in the presentation. This video discusses how to install 3M Dirt Trap.

Special diagnostic tools may be required to determine spraybooth problems.

When a spraybooth does not operate properly, there is specialized diagnostic equipment that may be used to determine the cause of the problem. These tools include a:

- maintenance checklist.
- velometer.
- smoke generator.
- particle counter.
- light meter.

A velometer measures the exchange of air through a spraybooth.

Velometers are used when there may be a concern about airflow problems within a spraybooth. These meters measure the amount of air flowing through the spraybooth.

A smoke generator is used to show how airflow is directed over the surface of a vehicle.

Smoke generators are used to observe the amount and direction of airflow through a spraybooth. The technician uses the smoke generator to emit smoke around a vehicle positioned in a spraybooth to determine the path the smoke takes to the exhaust filters.

Shown is a particulate counter.

The main function of the particulate counter is to:

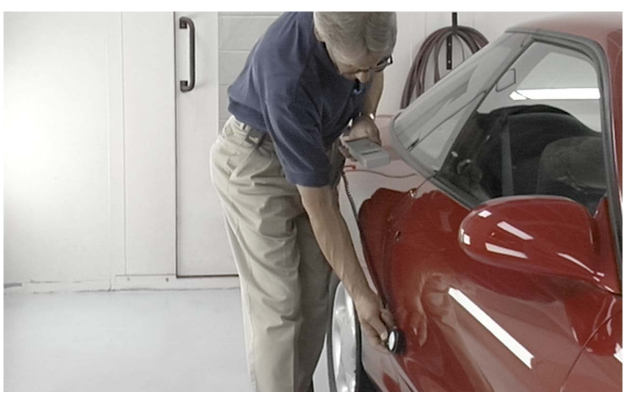
- measure the amount of debris in the air.
- determine if the amount of debris is excessive.

- help determine replacement intervals for the spraybooth filters.

Spraybooth lighting should be as close to natural daylight as possible.

Spraybooth lighting has three important variables. These variables include:

- color temperature. Color temperature is measured in Kelvin.
- color rendering index, or CRI. The CRI should be greater than 93%.
- candlepower. Candlepower should be 5 - 10k foot candles.

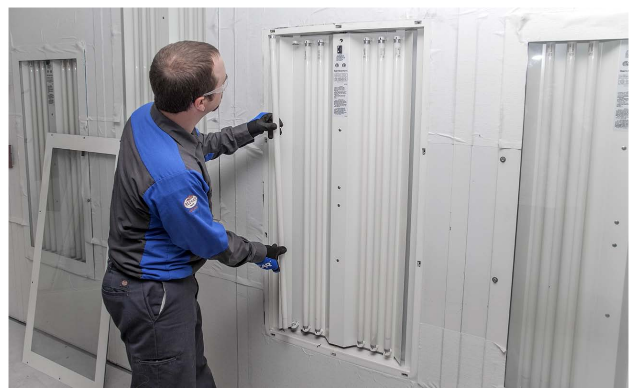


The technician is using a light meter.

While using a light meter, the technician should be able to:

- determine the current color rendering index (CRI) of the spraybooth lighting. The CRI is how close to natural daylight the lighting is.
- determine the current candlepower of the spraybooth lighting.

If any of these measurements show to be below the proper level, the glass lenses should be cleaned and the levels rechecked. If still incorrect, bulb replacement is required.



Spraybooth light bulbs should be replaced on a regular basis.

Spraybooth lights should be replaced on a regular schedule. Failure to replace spraybooth lights may cause problems, such as:

- bulbs changing color with age.
- bulbs burning out at various times during spraybooth operation and use.
- poor color matches.

Module Wrap Up

Topics discussed in this module included:

- the types of spraybooths currently in use.
- the various adjustments that can be made within a spraybooth.
- the different controls and settings of a spraybooth.
- how to maintain a spraybooth.

Module 4 - Mixing Equipment

This page is intentionally left blank.

Mixing Room And Tools

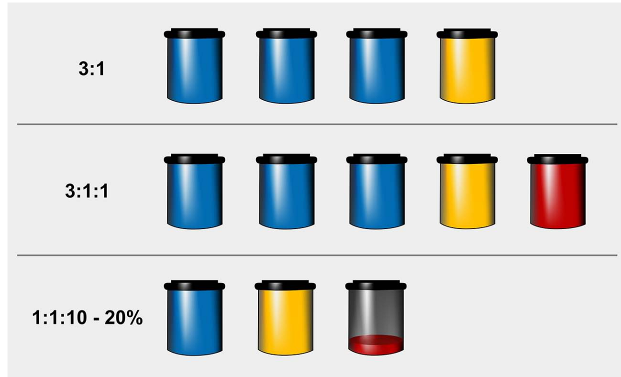
Learning objectives for this module include:

- explaining mixing ratios.
- describing the difference between cotton and nylon paint strainers.
- describing how and where mixing sticks and cups are used.
- explaining how to dispose of excess refinish materials.

Mixing rooms contain the materials and equipment for preparing refinish materials.

The paint mixing room is designed to:

- be self-ventilating.
- contain any spills that occur.
- meet local fire codes.
- be grounded to avoid sparks and explosions.
- have explosion-proof wiring.



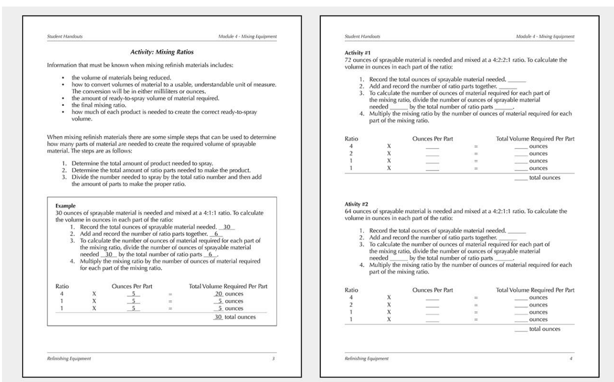
Different amounts of material are needed for different mixing ratios.

Most products used for refinishing in the automotive collision repair industry require that they be mixed or reduced. Depending on the type of paint system there can be different mixing ratios used.

Some of the mixing ratios may include:

- 3:1 = 3 parts to 1 part. A 3:1 ratio is taking parts of two products and mixing them together. Examples of this are mixing: 3 oz of one primer and 1 oz of hardener or 10.5 oz of one primer and 3.5 oz of hardener.
- 3:1:1 = 3 parts to 1 part to 1 part. A 3:1:1 ratio is taking three products and mixing them together. Examples of this are mixing: 3 oz of primer and 1 oz of hardener and 1 oz of reducer or 10.5 oz of primer and 3.5 oz of hardener with 3.5 oz of reducer.
- 1:1:10 - 20% = 1 part to 1 part + 10 - 20% of a part. A 1:1:10 - 20% ratio is taking equal parts of two products and mixing them together. Then by doing a math

equation, figure out from the mixed product how much of the mixed product is 10 - 20%, then add that 10 - 20% quantity of the third product. Examples of this are mixing: 1 oz of paint and 1 oz of reducer and then 0.1 - 0.2 oz of atomizing agent or 15 oz of paint and 15 oz of reducer and then 1.5 - 3.0 oz of an atomizing agent.



Student Handouts Module 4 - Mixing Equipment

Activity: Mixing Ratios

Information that must be known when mixing refinish materials includes:

- the volume of materials being reduced.
- how to convert volumes of material to a usable, understandable unit of measure. The conversion will be in either milliliters or ounces.
- the amount of ready-to-spray volume of material required.
- the final mixing ratio.
- how much of each product is needed to create the correct ready-to-spray volume.

When mixing refinish materials there are some simple steps that can be used to determine how many parts of material are needed to create the required volume of sprayable material. The steps are as follows:

1. Determine the total amount of product needed to spray.
2. Determine the total amount of ratio parts needed to make the product.
3. Divide the number needed to spray by the total ratio number and then add the amount of parts to make the proper ratio.

Example
30 ounces of sprayable material is needed and mixed at a 4:1:1 ratio. To calculate the volume in ounces in each part of the ratio:

1. Record the total ounces of sprayable material needed. 30
2. Add and record the number of ratio parts together. 6
3. To calculate the number of ounces of material required for each part of the mixing ratio, divide the number of ounces of sprayable material needed 30 by the total number of ratio parts 6.
4. Multiply the mixing ratio by the number of ounces of material required for each part of the mixing ratio.

Ratio		Ounces Per Part		Total Volume Required Per Part
4	X	5	=	20 ounces
1	X	5	=	5 ounces
1	X	5	=	5 ounces
				30 total ounces

Refinishing Equipment 3

Student Handouts Module 4 - Mixing Equipment

Activity #1
72 ounces of sprayable material is needed and mixed at a 4:2:2:1 ratio. To calculate the volume in ounces in each part of the ratio:

1. Record the total ounces of sprayable material needed. ______
2. Add and record the number of ratio parts together. ______
3. To calculate the number of ounces of material required for each part of the mixing ratio, divide the number of ounces of sprayable material needed ______ by the total number of ratio parts ______.
4. Multiply the mixing ratio by the number of ounces of material required for each part of the mixing ratio.

Ratio		Ounces Per Part		Total Volume Required Per Part
4	X	____	=	____ ounces
2	X	____	=	____ ounces
1	X	____	=	____ ounces
1	X	____	=	____ ounces
				____ total ounces

Ativity #2
64 ounces of sprayable material is needed and mixed at a 4:2:1:1 ratio. To calculate the volume in ounces in each part of the ratio:

1. Record the total ounces of sprayable material needed. ______
2. Add and record the number of ratio parts together. ______
3. To calculate the number of ounces of material required for each part of the mixing ratio, divide the number of ounces of sprayable material needed ______ by the total number of ratio parts ______.
4. Multiply the mixing ratio by the number of ounces of material required for each part of the mixing ratio.

Ratio		Ounces Per Part		Total Volume Required Per Part
4	X	____	=	____ ounces
2	X	____	=	____ ounces
1	X	____	=	____ ounces
1	X	____	=	____ ounces
				____ total ounces

Refinishing Equipment 4

Mixing cups, viscosity cups, paint filters, and mixing sticks are all important tools needed to help create a quality refinish.

The tools that may be needed when mixing refinish materials include:

- mixing ratio cups and sticks, which are used for obtaining the proper blend of materials.
- a lint-free strainer. Strainers should be tested for resistance to solvents and water. Soak the strainer for a couple minutes in water and also in solvent. Debris could end up in the paint cup if there is any change to the strainer. Strainers also should have nylon mesh instead of cotton. This is because cotton has lint that can be deposited into the paint cup.
- a viscosity cup. A viscosity cup is used to gauge how fast a material can pass through a given size orifice. This will then determine the spray gun setup that is needed.

Mixing ratio cups have graduated scales on their sides.

Mixing ratio cups are used for mixing paint, reducer, and hardener. Mixing ratio cups may have graduated scales on the sides of the cup to aid in proper mixtures. Different mixing ratio cups may have:

- a scale for mixing.

- parallel sides. The bottom of the mixing ratio cup should be perpendicular to the sides to help ensure proper mixing is attained.
- a graduated scale for cups that have nonparallel sides.

Mixing sticks typically have specific mixing ratios embossed on them for ease of use and reuse.

Mixing sticks are available by most paint makers. Paint makers that offer mixing sticks will have mixing sticks needed to support their mixing formula requirements. When using mixing sticks, guidelines must be followed. When using a mixing stick:

- place the stick in a container and follow the appropriate scale.
- do not set them at an angle.
- the scales must be followed exactly.
- use containers with nontapered sides.
- the correct stick from the paint maker needs to be used. Each paint maker has their own set of mixing sticks made especially for their ratios.

Viscosity cups are used to measure the thickness of the refinish material.

Viscosity cups are used to measure the rate of material flow. There are different types of viscosity cups. Be sure to use the correct cup for the application requirements. Different type of viscosity cups may be able to be interchanged in some applications. Three common viscosity cups used include the Zahn, Ford, and Din cup.

Shown is a solvent recycler.

Used material containers are designed for holding small amounts of waste for a short period of time. These containers may also:

- contain a double strainer for collecting material.
- hold used material until placing into larger holding drums.

When using a used solvent container, it is a safe practice to use a system that has a cover and keeps fumes from escaping. If an uncovered container is used, the fumes can cause a fire and health hazard.

Module Wrap Up

Topics discussed in this module included:

- mixing ratios.
- the difference between cotton and nylon paint strainers.
- how and where mixing sticks and cups may be used.
- the disposal of excess refinish materials.