Module 7.0 Troubleshooting-Overview

The purpose of this section is to help you identify, solve, and ultimately avoid common finish problems. The more you know about coatings and some of the most common issues that can arise when using them, the more effective you will be in resolving issues and avoiding problems in the first place. In this section we will cover specific problems, what causes them, and solutions.

Common Denominators

Following are some common denominators in wood finishing that can contribute to problems in the finish room.

7.1 AGITATION

Agitation is a simple concept; but surprisingly is the cause of many finish issues. Too many finishers simply do not mix their paint properly before use. Proper agitation before and during use is critical to the finishing process. Flattening agents, colorants, and catalysts need to be in proper suspension and fully mixed in to solution for sheen, color, and curing to be correct when the material is applied. Coatings may be agitated either manually (like with a stir stick), or mechanically. There are many very good commercially available air driven agitators that fit both on drums, and five gallon pails.

These are ideal for keeping the material *slowly* agitating while in use. Running these types of agitators at a moderate speed is the key. Running a mechanical agitator at too high a speed may result in forcing air into the coating which will cause it to foam. It is always a good idea to loosen and scrape the material off of the bottom of the container before turning the agitator on. Some material will settle hard enough (especially over time), that an air powered agitator may not be able to force all of the material onthe bottom of the container into suspension. If manually agitated, the material should be stirred by hand frequently after it is initially mixed up, otherwise the flattening agent may begin to settle which will immediately affect the gloss of the coating.

7.2 TEMPERATURE

SUBSTRATE TEMPERATURE

The temperature of the substrate has a direct effect on the finish. Temperature changes the working characteristics of the finish being applied, and since finish materials almost immediately take on the temperature of the substrate to which they were applied, it is important for the wood to be at a reasonable temperature. Generally speaking substrate should be *at least* 65-75 degrees Fahrenheit if possible. Waterbased coatings and UV cured products can be very temperature sensitive and board surface temperature (BST) must be carefully monitored and controlled.

PRODUCT TEMPERATURE

To assure proper flow, dry time, and overall performance of the coating, it is recommended that the product temperature be as close to the substrate temperature as possible. Care should be taken to keep both above 65 degrees Fahrenheit. As a coatings temperature decreases, the coatings viscosity will increase substantially making it difficult to spray and cause problems such as micro-foam and orange peel. The reverse is true as well. As a coatings temperature increases, the viscosity will *decrease*. Thinners can help compensate for high viscosity caused by improper product temperatures, but doing so also reduces the solids of the coating. Best practice is to keep the coatings temperature within the recommended range.
The table below shows how viscosity is affected by temperature.

Product “A”

Temperature Fahrenheit	Temperature Celsius	Viscosity
95 degrees	35 degrees	21 seconds
77 degrees	25 degrees	26 seconds
65 degrees	18 degrees	30 seconds
55 degrees	13 degrees	39 seconds

In this case Product “A” has been designed by the manufacturer to spray and perform well at a viscosity of 26 seconds in a #2 Zahn cup, (the correct viscosity reading when the material temperature is 77 ° F.). At 65° the viscosity increases to 30 seconds or higher it will likely not spray and flow as well, possibly resulting in a textured appearance. At 55° the viscosity increases to 39 seconds and the product will likely be almost un-sprayable; a direct effect product temperature!

CATALYZED MATERIALS, WATERBORNE COATINGS AND TEMPERATURE

It cannot be stressed enough how important temperature is to a coating that cures by chemical reaction alone i.e., conversion varnishes and other similar post catalyzed products. These types of products may not cure properly if they are cured in temperatures less than 65˚F. That means the air, substrate and material temperature should be at least 65˚F for the material to cure properly. If the material is applied in temperatures substantially lower than this, there is a possibility that the performance in the field (water and chemical resistance, flexibility) will suffer because the product will not cure properly/completely. Pre-catalyzed products can be affected as well but to a lesser degree.

Waterborne coatings may not coalesce (form a film) if the temperature of the air, substrate, and material is too cold. This can give the coating a “cracked” or textured appearance because the resins are able to form a complete film.

7.3 HUMIDITY

Humidity can affect dry time as well as the appearance of a coating. When the air is saturated with water, solvents and water evaporate more slowly, causing the coating to dry slower. High humidity can also cause blushing, and even wrinkling in certain situations due to slower curing of the system.

MOISTURE CONTENT OF THE SUBSTRATE

Wood is a hygroscopic material. When exposed to air it will release or absorb moisture until it is at equilibrium with the humidity and temperature of the air. When wood absorbs moisture it swells and becomes increasingly dense; when wood loses moisture it causes the wood to shrink and become less dense. This swelling and shrinking does not occur equally in all directions.

Generally speaking, moisture content for wood used in kitchen cabinetry and furniture should be in the 7-9% range for optimum finishing. When measuring moisture initially, units of wood should be broken apart and tested in several spots; wood does not dry uniformly even in the same board. As wood is being worked it will begin to reflect the ambient temperature and humidity of the shop. Without environmental control, wood may be out of specification by the time it is finished.

Even after finishing wood will continue to change in moisture content, both long term (seasonal), and short term (such as daily),as fluctuations in relative humidity and temperature of the surrounding air occur. Moisture content changes may be slowed, but not prevented, by protective coatings such as varnish, lacquer, or paint. The idea is to work, finish, and ship the product in a way that will minimize moisture content changes of the wood in service.

Excess moisture in wood, particularly hard, closed grain woods like maple, can cause poor adhesion. Finishes may not adhere properly to wet, overly dense substrate. Wiping stains will finish lighter on wet wood, and spray stains may appear mottled because they stay too much on the surface. Wood that is too dry may stain too darkly. Over dry wood may also absorb sealer and topcoat materials, producing a dry or “hungry” finish.

Dimensional changes resulting from wood that is not properly dry can cause cracking in a finish over time, particularly in joints. Control of moisture content is essential to a quality finish.

7.4 SANDING

White wood sanding is the first and most critical step in finishing. Improper white wood sanding can have a dramatic effect on color, adhesion and appearance. Properly performed, sanding is a multi-step process. Rough boards will typically be sanded with 80-100 grit to start, then 120,150 etc. working their way up to the final sanding grit before beginning the finishing process. That statement begs the

question…what is the best grit for final sanding? Since each wood varies in density, porosity, and hardness, this can vary.
Here are our recommended guidelines.
Red Oak, White Oak, Ash, Cherry, Alder, Hickory, Mahogany, Poplar, Pine, Walnut-Final sand should be 150-180 grit. It is acceptable to go up to 220 grit on Alder, Poplar, and Pine if needed.

Maple, Birch, Beech, - 120-180 grit max
Maple especially, is so dense and hard, that sanding finer than 180 grit will tend to polish the wood beyond just sanding. When sanded this fine, stains will have a difficult time penetrating the wood. Seal coats will also have a hard time penetrating the surface leading to poor adhesion, even without using a stain first.

Sanding and color
Sanding can have a profound effect on the final color. Simply using a different grit of sandpaper on a job can cause a noticeable change in color.
The courser the grit- the darker the color
The finer the grit- the lighter the color
Using a coarse grit will make the surface rough and opens the pores allowing the stain to penetrate further, causing the color to be darker. Finer grit papers smooth the surface and close the pores keeping the stain from penetrating as much, resulting in a lighter color.

Between coats
Sanding between coats (called scuff sanding) is critical in achieving a smooth surface on which to apply the next coat, as well as providing mechanical adhesion. Conventional nitrocellulose lacquers are the only coatings that truly “melt in” to the previous coat since there is no chemical reaction involved and the resins are easily softened again by the solvents in the following coat. That being said, you should always sand between coats (even nitrocellulose) to rid the surface of any defects, or particles in the finish.
For all other products sanding is critical for adhesion. Many resin systems, especially those used in catalyzed coatings, will not be softened by the next coat and require a sand scratch for mechanical adhesion. Sanding should be performed just before applying the next coat. Why? Because as a coating dries and cures, it extends and stretches out to lay flat. If the parts sit for a time after they have been scuff sanded (say over a weekend) the sanding scratches will stretch and flatten out; the sharp edges of the sand scratch will round over and leave too smooth a surface for the next coat to adhere to. A catalyzed system will dry very hard, even overnight, and will rely exclusively on this mechanical bond for adhesion.

7.5 EQUIPMENT SET UP

Poorly adjusted equipment can make a great coating look bad. Incorrectly adjusted air pressure, fluid pressure, or a plugged or dirty tip or aircap can cause a myriad of problems ranging from orange peel and striping, to runs and sags. Knowing how to properly adjust and spray with different types of equipment is key in being able to identify and avoid problems.

7.6 PROPER HANDLING OF CATALYZED COATINGS

Catalyzed coatings provide a superior finish but have their own challenges as well. There are a few consistent problems that are caused by the mishandling of a catalyzed coating. The first thing to remember is that the catalyst amount and pot life listed by the manufacture is not a "guideline". These must be strictly followed to avoid problems in both the finish room and the field. A couple of common misconceptions are that "more catalyst will make the coating dry faster", and "it's good as long as I can still spray it". If there is excess catalyst added to the coating it will begin to precipitate out of the coating once the coating is dry and create a hazy, greasy looking film, with a very unpleasant acidic odor on the surface. This is called catalyst bloom. Excess catalyst may also make the film brittle causing the finish to crack. These problems may not show up until the job is installed. At that point everything needs to be stripped and re-finished.

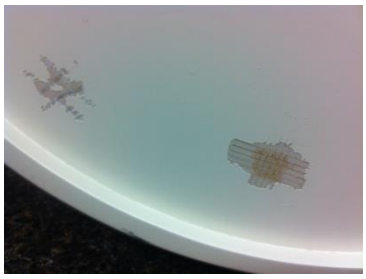
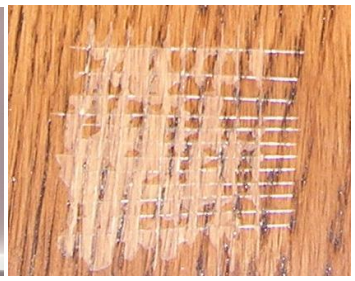
After a coating has been catalyzed for a time it begins to crosslink in the container. Manufacturers test these materials thoroughly to determine the pot life for a particular material. Samples are sprayed and tested freshly catalyzed, and also at the maximum recommended pot life to make sure that the product performs as expected within that recommended time frame. Spraying material that is past its pot life may result in a hazy finish, cracking, or poor water and chemical resistance in service. Even though it may still look spray-able, it is simply not worth the risk.

7.7 SOLVENTS

Solvents can be an excellent tool for meeting the challenges that Mother Nature throws at a finisher. Hot weather, cold weather, and humid weather, are all situations that may require the use of solvents to adjust a coating so that it works well in a particular situation. However, the misuse of these same solvents can be the *cause* of many finishing problems. The components of lacquer thinners, reducers, and retarders can vary greatly between manufacturers which means these products are not necessarily interchangeable. The solvent makeup may be *drastically* different. That is why each manufacturer recommends specific solvents and amounts to add for each individual product. These recommendations are designed to assist the finisher in making their job easier in adverse conditions. Adding the wrong solvent or the incorrect amount of solvent, can lead to problems such as: drying too fast, drying too slow, hazy film, moisture blushing, solvent blushing, lifting/wrinkling, turning the coating chunky or seedy, runs, sags, and more.

7.8 Troubleshooting- Specifics

ADHESION

The problem: Coating is chipping off or is easily scratched or rubbed off the surface

Key thought- AT WHAT LAYER IS THE ADHESION FAILING? STAIN, WOOD, PRIMER?

Possible causes	Countermeasures
Improper sanding of white wood or sanding between coats not sufficient, or done with too fine a grit	Make sure bare wood is not over sanded or polished. Sanding between coats should be completed just before applying the next coat with paper no finer than 320 grit.
Too much stain left on the surface, or stain not dry before recoating	Wiping stains should be wiped clean with all of the excess stain removed. Follow dry times listed on the Product Data Sheet.
Too much glaze left on the surface, or glaze not dry before recoating	90-95% of the glaze should be removed. Follow dry times listed on the Product Data Sheet.
Fast dry, causing the stain or coating to sit on top of the wood and not properly penetrate the wood fiber.	Slow the dry of the coating with the recommended retarder
Incompatible products used in the system	Stick with the manufacturers recommended system. Some products will have adhesion issues no matter how long they dry, or how well they are sanded.

ACID BLOOM

The problem: A hazy, greasy film that forms on the surface of a finish. It typically has an unpleasant acidic odor. If wiped clean, the hazy appearance returns.

Key thought- IF THE SURFACE IS HAZY AND SMELLS LIKE VOMIT, TOO MUCH CATALYST HAS BEEN ADDED.

Possible causes	Countermeasures
Too much catalyst has been added to the coating	Strip and refinish

BLUSHING-MOISTURE BLUSH

The problem: The surface of the coating has a milky appearance, or in some cases, has turned completely white. Moisture blushing occurs when fast drying solvents cool the surface of the substrate you are finishing and moisture condenses on the cooled substrate.

Key thought- NEED TO SLOW THE COATING DOWN

Possible causes	Countermeasures
Spraying when relative humidity is high	To avoid the blush, add recommended retarder <u>before</u> spraying to slow the dry time. To fix a blushed piece, add the recommended retarder to the coating, scuff sand the piece and re-spray. Retarder may also be sprayed directly on the blushed surface.
Product has been thinned with a solvent that is too fast	Add recommended retarder to slow the dry time

BLUSHING-SOLVENT BLUSH

The problem: The surface of the coating has a milky appearance similar to a moisture blush. Solvent blush usually occurs when a glaze or stain has been coated before all the non- active or “diluent” solvent from the stain or glaze has evaporated and it gets trapped in the coating. Typically, solvents used in wiping stains and glazes (for example mineral spirits) are not active for nitrocellulose and other resins and therefore cannot pass through the film. They get trapped inside the film and cause the “blush”.

Key thought- HOW LONG DID THE STAIN OR GLAZE DRY?

Possible causes	Countermeasures
Stain or glaze has been recoated before it was dry	Follow dry times listed on the Product Data Sheet. To fix a blushed piece, add the recommended retarder to the coating, scuff sand the piece and re-spray. Retarder may also be sprayed directly on the blushed surface.
Improper solvent added to the coating	Always consult the Product Data Sheet for recommended thinners

BUBBLES, MICROBUBBLES, BLISTERS



Figure 1 Figure 2 Figure 3

The problem: Bubbles (figure 1)are visible and break the surface in the dried film. This happens when the coating dries and skins over before all of the solvent and air from the pores of the substrate can pass through the film. When the bubbles are very small and trapped beneath the surface of the coating the phenomenon is referred to as micro-foam or microbubbles (figure 2). Blisters (figure 3)are much larger (sometimes larger than a pencil eraser head) and are generally a result applying heat too quickly before the solvents in the coating have had a chance to flash off, or the temperature in the oven may be set too high. Water in the coating or on the surface of the substrate, and poor quality veneer can also be the cause of blisters.

Key thought- COATING IS SKINNING OVER BEFORE BUBBLES CAN BREAK…..WHY?

Possible causes	Countermeasures
Too much coating applied	Follow wet mil recommendations on the PDS. Use a wet mil gage to measure the amount of product being applied and reduce the amount of product applied if needed to match the PDS.
Coating has become high in viscosity due to solvent loss or cool temperatures	Reduce with recommended thinner to correct application viscosity listed on the PDS. Warm product to 77˚ F.
Too much air movement in the finish/drying area	Eliminate air movement. Move parts to an area with less air movement to flash off.
Ambient temperature is very hot	Add recommended retarder to slow flash and dry times.
Incorrect thinner used i.e., too fast evaporating	Add recommended retarder to slow flash and dry times.
Leak in the siphon hose to a high pressure spray unit i.e., airless or air assisted equipment	Replace hose.
Veneer issues	Try applying a very light (1-1.5 mil) dust coat let dry to touch and then apply a normal coat.

CRACKING

The problem: Cracks in the finish. Cracks that go across the grain are usually what are referred to as “cold checking”. This is typically what happens when more than the recommended number of coats is applied. The finish cracks when it is “stressed” either by temperature or changes in humidity which causes the substrate to move. Smaller cracks or spiderweb cracks typically appear when a product has been over-catalyzed or has not cured correctly.

Key thoughts- TOO MUCH COATING APPLIED, IMPROPER CURING

Possible causes	Countermeasures
Too many coats. Dry film thickness is too high	Apply only the recommended amount of coats. Strip and refinish parts that have cracked.
Too much catalyst added if a catalyzed coating	Is there an apparent catalyst bloom? Does the coating smell like vomit? This is a dead give-away that the product has been over catalyzed. Strip and refinish parts that have bloomed or cracked.
Heavy Application	Apply the product only at the recommended wet film thickness listed, and let dry per the recommendations on the PDS . Heavy coats, applied too quickly can lead to improper cure and cracking.
Poor Inter-coat Adhesion	Make sure each coat is sanded properly with the recommended type and grit of sandpaper. Also, for catalyzed finishes, make sure sanding is performed just prior to re-coating. If sanded parts have sat over a weekend, re-sand before applying the next coat.
Catalyzed product subjected to extreme cold temperatures before completely cured	Catalyzed products should cure @ a minimum of 65˚ F for at least a week before being transported in cold temperatures. Do not store finished parts in cold temperatures, especially for long periods of time.

DRY SPRAY

The problem: Coating appears dry and rough similar to overspray, and is not “wetting out”. Gloss appears low. Key thought- POOR TECHNIQUE, FAST DRY

Possible causes	Countermeasures
Spraying technique is too fast, gun is held too far away from the surface, or overlap is insufficient	Move gun closer to the part and slow down. Gun should be approximately 6-8 inches away from the part. Each pass of the gun should overlap the previous pass by at *least* 50%
Spray gun atomizing air pressure too high or fluid pressure set too low (conventional spray or low pressure setup)	Reduce atomizing air pressure or increase fluid flow.
Incorrect thinner used i.e., too fast	Add recommended retarder to slow dry

FISHEYES (CRATERS)

The problem: This problem occurs when the coating is not able to wet the substrate completely. Craters are formed as the coating flow around the contaminated area. This is usually due to some form of contaminate on the surface of the substrate, or contamination of the coating.

Key Thought-CONTAMINATION, FIND THE SOURCE

Possible causes	Countermeasures
Surface contaminated by silicone, over spray dust, grease, water	Make sure the surface to be coated is free of contaminates, overspray and dirt.
Air Supply used to supply air to the gun or to blow off parts contaminated by oil, water, etc.	Make sure a good quality air regulators and filters are installed in the air line. Make sure any compressors supplying air are drained regularly.
Airborne contaminants-aerosol saw blade lubricants, waxes, Cleaning supplies like Windex, 409 etc.	Avoid using any of these products in or near the finish room.
Lotions, greasy foods etc that may originate from finish/sanding personnel or anyone else required to touch parts	Require all employees to wash their hands thoroughly after breaks, lunches etc.

Remove the material from the shop in question and spray it in a different location with different equipment and on different substrate. If the fisheyes disappear, the issue lies somewhere in the shop. If the fisheyes persist, the coating has been contaminated. If the issue is in the shop, a process of elimination must be employed to locate the source.

Follow this 10 step process and more than likely you will identify the cause of the fisheyes.

10 step process of elimination

1. Spray from a new container of the same batch
2. Spray from a new container of a different batch
3. Spray using different equipment

4. Spray on different substrate
5. Spray material in question at a different location, with different equipment, on different substrate.
6. Check air supply system, check compressor for water, check air line water and oil traps, make sure they are working and that the air used to supply air to the spray guns and to blow off parts is clean and dry.
7. Check finish area for cleaners (409, Windex), lotions, food, etc., anything that could be either transferred to parts while being handled and sanded, or could be airborne and settling on parts waiting to be finished.
8. Check the mill area (table saws especially) for any type of aerosol lubricant used for saw blades or table tops etc., that could be contaminating parts.
9. Check for rags or tack rags used to wipe off parts in between coats that may be dirty or contaminated.
10. What is being used to agitate the coating? Sometimes an old stir stick or something else used to mix the material can be the culprit.

GLOSS

The problem: Gloss is lower or higher than expected.

Key Thoughts- AGITATION, CURE.

Possible causes	Countermeasures
Coating has not been agitated sufficiently before and during use	Locate a new container of the same batch, mix thoroughly and re-check gloss. Coatings should be mixed thoroughly before use and continuously during use.
Coating has not cured sufficiently	Catalyzed coatings especially, may require up to 24 hours to die down to the correct sheen. Also, if using a catalyzed product, ensure that the correct amount of catalyst was added to the coating
Improper application	A rough or textured surface will appear low in gloss. Make sure product is at the correct viscosity and that the equipment as well as spray technique are correct.
Coating has been reduced too much, or too much retarder has been added.	Thinning reduces the solids of the coating and if done excessively will appear low in gloss because the solids have been drastically reduced. Coatings can appear higher in gloss than normal when an excessive amount of retarder has been added

LIFTING/WRINKLING

The problem: Small wrinkled or puckered areas on the coating surface. They look similar to a crack that has pronounced raised edges. This happens with catalyzed coatings typically when the coating is in a 'green" state- (partially cured). For a finished surface to be recoated successfully, it needs to be completely soluble in, or completely impervious to the next coat applied.

Key thoughts- CURE, COMPATIBILITY.

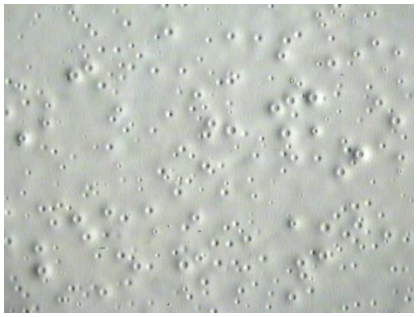
Possible causes	Countermeasures
Under-cured coating due to: Heavy application of the previous coat, insufficient curing temperatures, excessive slow solvent added, incorrect catalyst amount	Make sure correct catalyst and amounts have been used. Wait 48 hours and try re-coating again. Ensure that curing temperatures are adequate- ideally at least 78˚ F (25˚C)
Poor inter-coat adhesion	Make sure surface is scuff sanded sufficiently and only just before the next coat is applied
Incompatible products in the system	Do not mix systems, such as using a conventional lacquer sealer being applied under a CV.

ORANGE PEEL OR TEXTURE

The problem: Surface is rough or textured like the surface of an orange. Key thoughts- HIGH VISCOSITY, MATERIAL TEMPERATURE, TECHNIQUE

Possible causes	Countermeasures
Viscosity is too high due to solvent evaporation or coating that is cold	Add recommended thinner until the correct viscosity is achieved. Warm the coating
Fast dry	Add the recommended retarder to slow the dry time
Substrate temperature and coating temperature are significantly different	Warm the substrate and coating until the temperature of each is relatively equal and as close to 77° F (25° C) as possible
Improper spray technique-too fast, gun held too far away	Make sure gun is held 6-8 inches away and slow down if necessary. Make sure each pass is overlapped at least 50% into the previous pass
Equipment setup.	Check equipment settings. Make sure there is not too much atomizing air and that the fluid pressures are sufficient. This will vary with each type of equipment

PINHOLES

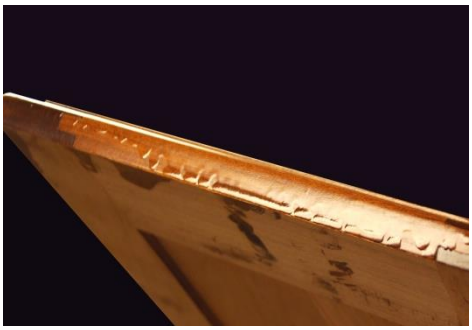


The problem: Small pore-like holes are apparent in the dry film. Especially noticeable on painted surfaces. The problem is caused by trapped solvents, air, or moisture. Key thoughts-IMPROVE THE FLOW, SLOW THE PRODUCT DOWN

Possible causes	Countermeasures
Heavy coats at high temperatures, or on a heated surface.	Apply material at the recommended wet mil thickness on the PDS. Add recommended retarder to the coating to slow it down if necessary. Make sure the coating and the substrate are close in temperature ideally close to 77˚ F (25˚C)

Substrate may be porous-fiberboard etc.	Try thinning the material slightly and adding a small amount of retarder. The lower the viscosity and the better the flow, the less likely pinholing is to occur
Incorrect thinner used-(too fast)	Add recommended retarder to slow the coating
Too thin of a seal coat applied on very porous substrate	Apply material at the recommended wet mil thickness on the PDS.

RUNS AND SAGS



The problem: Coating has collected heavily in certain areas, typically on vertical surfaces. This may be on edges, or even on the face of the parts.

Key Thoughts- HEAVY COAT, MATERIAL IS THIN, AMBIENT TEMPERATURE IS COLD

Possible causes	Countermeasures
Excessive application, spray gun held too close to the part, heavy coats on vertical surfaces, too large a tip used.	Spray only the correct wet mils recommended on the coatings PDS. Spray gun should be held at least 6-8 away from the part. Change to a smaller tip or needle/nozzle combination
Viscosity of the coating is too low, excessive reduction or too much retarder has been added	Obtain new material that has not been reduced and re-spray
Cold environment or substrate	Warm the substrate. Improve the temperature of the spray environment
Spray gun tip, needle, or aircap is dirty or defective	Check equipment for defective or dirty components. Clean or replace components and check gun pattern on a piece of cardboard