

PRODUCTS TECHNIQUES, INC.

AIRCRAFT PAINT APPLICATION MANUAL



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Introduction

The purpose of this document is to provide basic guidance on the processes of paint removal, surface preparation and paint application for the interior and exterior of your aircraft. If your aircraft is located at an airport and you are planning on performing any of these tasks yourself, you should first consult with your airport controller to see what work can and cannot be done on the airport's premises.

There are a number of topics to discuss, so let's begin.

First, prepare an inventory of the products you will need. Along with the products, we highly recommend that you acquire the technical data sheets that explain how the product is to be used and the conditions of use. All of the PTI products that are referred to in the following document have technical data sheets that can be accessed at our website: www.ptipaint.com, or on the Aircraft Spruce website at www.aircraftspruce.com. Or you can call PTI at 909-877-3951. The technical data sheets for the product and this manual are designed to be used together. Both need to be read and followed to obtain optimal results.

When it comes to the use of our products, PTI considers safety its number one concern. So, we highly recommend that, prior to application, everyone one who uses our products acquire and review the MSDS that is available for each product. The MSDS provides instructions on the appropriate safety equipment to use and what to do in case of an accident or an emergency. We also recommend that a copy of the MSDS be kept at the location where the products are being used so if there is an emergency, first responders know exactly what they are dealing with. If you cannot locate the Technical Data or MSDS from Aircraft Spruce please contact PTI on line or by phone.

It is important to appreciate and understand that a coating does more than just make the surface of your aircraft aesthetically pleasing. Any painter or paint manufacturer will tell you that paint and coatings must meet two essential criteria, **PROTECTION** and **BEAUTIFICATION**. PTI has made a commitment to focus on both of these aspects with the understanding that the two requirements have equal importance. Furthermore, the reason we coat items and more specifically aircraft, is because of the damaging effect that the surrounding environment has on the materials we use to construct aircraft. Also, once an aircraft has been properly painted it is easier to clean and maintain. Surfaces that have not been covered are much less resistant to corrosion, dirt and oils.

1. Environmental Effects on Unpainted Surfaces

Environmental conditions can pose a variety of problems for metals and composite materials that are not properly coated or left uncoated. Those problems differ depending on the material used. The three major materials used are steel, aluminum and composite substrates.

- The safety of pilots and passengers may be compromised due to corrosion of metals, rusting of steel, the degradation of polymers in composites and the rotting of wood when used as a structural member in fabric planes. Geography obviously affects the potential for the degradation of the materials. For example, the salt air in Southern California, the extreme heat of the Mojave Desert or the humidity in the Gulf States may cause the materials used to construct the plane to degrade at a faster rate than a warm dry climate. This makes coating your plane one of the most important parts of preserving its structural integrity. Let's discuss what happens to various substrates when exposed to the elements.

A. Alloys (Aluminum & Steel): Corrosion is the disintegration of an engineered material into its constituent atoms due to chemical reactions with its surroundings. Many structural alloys corrode merely from exposure to moisture, salts and other chemicals/minerals in the air or surrounding environment. Corrosion, most often referred to simply as "rust," can be concentrated locally to form rust, a pit or eventually a crack. Or, it can extend across a wide area more or less uniformly corroding the surface.

- Aluminum is an alloy that has proven to be extremely resistant to corrosion. Aluminum is actually a very active metal, meaning that its nature is to oxidize very quickly forming a protective film. While a weakness for most metals, this quality is actually the key to its ability to resist corrosion. When oxygen is present (in the air, soil, or water), aluminum instantly reacts to form aluminum oxide. This aluminum oxide layer (protective film) is chemically bound to the surface, and it seals the core aluminum from any further reaction. Aluminum's oxide film is tenacious, hard, and instantly self-renewing. According to the US Army Corps of Engineers, "Aluminum has excellent corrosion resistance in a wide range of water and soil conditions because of the tough oxide film that forms on its surface. Therefore it is an outstanding material for aircraft. When corrosion does affect the integrity of aluminum it usually occurs in the form of pits. This is how you determine whether you have a corrosion problem. The conditions under which start to show corrosion commonly occur in environments where UV light, salt and moisture are prevalent. Paints and other coatings are critical to the prevention of corrosion and to preserving the integrity of the structural members of whatever you are coating. For these reasons PTI has developed a system of coatings which allows materials such as metal to maintain their strength and properly perform to their intended specifications.

B. Composite Degradation: Corrosion is not limited to metals. Corrosion can occur in ceramics or polymers, although in this context, the term degradation is more commonly used. Owners of composite aircraft should be careful to avoid what is called composite degradation. Composite or Polymer degradation is present where there is a change in the properties of the composite – changes in tensile strength, color or shape are the most common. Degradation occurs due to the influence of one or more environmental factors such as heat, light or chemicals such as acids, alkalis and some salts. These changes include cracking and depolymerisation of products which will lower the molecular weight of a polymer. The changes in properties are often termed "ageing". Polymeric molecules are very large (on the molecular scale), and their unique and useful properties are mainly a result of their size. Any loss in chain length lowers tensile strength and is a primary cause of premature cracking. This cracking often occurs during use and over a period of time can lead to a lack of integrity in the composite. This process severely increases the chance of substrate failure.

2. Safety (PPE, Personal Protection Equipment)

Because painting, stripping, sanding, refinishing, touching up and blasting requires exposes you to, chemicals, vapors, mist, dust or airborne debris and other materials that may be hazardous it is important and necessary to use Personal Protection Equipment (PPE). Standard PPE includes chemical resistant gloves, goggles and clothing – a Tyvek suit – as well as a charcoal filtered respirator.

Your respirator should provide a tight seal over the nose and mouth to prevent inhaling any dust from sanding and the vapors, fumes, mist and/or overspray from the application of paints, lacquers and enamels. Respirators have filters – cartridges or canisters – that remove contaminants from the air by passing the ambient air through the air-purifying element before it reaches the user.

- You will know that it is time to change your filters when you experience breathing irritation in your nose or throat, if you detect an odor inside the mask or if there is a change in breathing resistance. Even when using a respirator you should still make sure that you are in a well ventilated area. If for any reason you start to feel nauseous or dizzy, immediately and carefully leave the area and relocate to an area where you can breathe fresh air.

Goggles should be splash and vapor resistant to protect the eyes from splatter, vapor and/or fumes. The goggles need to provide a tight seal and should be fog resistant. Wearing goggles, when cleaning your equipment, is also important, especially when cleaning with solvents. Face and eye protection especially when spraying any paint product is essential. Thousands of people a year are blinded from work-related eye injuries. According to the Bureau of labor statistics, three out of five workers are injured while failing to wear eye and face protection.

Rubber gloves should be worn whenever handling any strippers, etching compounds, solvents, paints or coatings are being used. When stripping paint with Methylene Chloride based paint strippers it is recommended that butyl or neoprene gloves be used. Your standard solvent resistant gloves will not stand up to Methylene Chloride's volatile characteristics.

Forced air breathing systems should be used in place of charcoal filter respirators whenever you are spraying coatings that contain isocyanides or chromates. They should also be used when using chemical strippers that contain Methylene Chloride or when stripping using an abrasive blasting method. Forced air breathing systems provide constant fresh air from a high capacity electric air turbine. Most systems come with 200 feet of hose through which fresh air flows from the turbine air pump intake that is to be placed where fresh air can be accessed.

Be sure that all of your electrical equipment is explosion proof. Many of the materials used when painting, if not all, are flammable. Anything that causes a spark can ignite liquid and vapor chemicals. Keep all areas free of flames.

3. What are VOC's

Users of PTI's products must be mindful of the VOC content of those products. VOC is an acronym that stands for **Volatile Organic Compounds** (VOCs) are organic chemical compounds that have high enough vapor pressures under normal conditions to significantly vaporize and enter the earth's atmosphere. Volatile organic compounds are numerous and varied. In our modern industrial society they are considered harmful or toxic, particularly when sprayed. VOCs, or subsets of the VOCs, are often regulated. With that in mind, please spray or apply our products according state and/or local government regulations. Even though all of the products mentioned are low VOC many cities and counties have restrictions on the amount of product you can apply depending on your facilities and application process.

4. Paint Removal – Metal and Composite Surfaces

Before stripping a plane regardless of the method it is necessary to first consult your airport controller to see what they allow. Also, to preserve the surrounding environment, it is crucial to contain stripped paint and other chemicals from running off into drains. Therefore, at a minimum, ground containment should be set up. For smaller aircraft, you can roll the plane onto thick gage plastic that stretches past the ends of the wings, nose and tail of the aircraft. A sandbag dam should be set up under the edges of the plastic when using chemical strippers to prevent runoff. Laying down plastic, especially with a dam, contains contaminants very well and provides an easy method of clean up and disposal. Larger aircraft should always be stripped in an approved facility where the aircraft can be stripped at a wash station where tanks, interceptors and/or debris containment are available to safely contain large amounts of hazardous material. There are 3 traditional methods to remove paint from an aircraft. The most time consuming method is to sand down the painted surface until you reach the metal substrate. This method is probably the least recommended. You need a team of people with the proper tools and it will still take significantly more time than other traditional methods. Also, it is extremely dusty.

- The sanding method is usually employed when the painter is trying to remove the topcoat, enable adhesion between old and new paint or where the primer has failed and is no longer adhering to the metal substrate.
- Using this method means that the primer must have good adhesion over the majority of the aircraft. Where adhesion has failed it is important to sand the lifting or cracked primer and expose the metal.
- As a general rule, the area where the primer is lifting plus 20% on all sides should be sanded until you only see primer with good adhesion and clean metal. Once that is done, you can prime the areas where metal is exposed before applying the polyurethane topcoat.
- Sanding to prepare the surface for painting is common for composite surfaces as well. Begin with 100 grit sand paper. Be mindful that you do not scratch the composite substrate when sanding off all the paint and primer. Once the topcoat has been sanded away and you see the primer switch to a finer grit of sand paper to prevent damage – 240 grit or 320 grit.

Another method for removing paint is plastic media blasting. Plastic media blasting is quick but requires expensive equipment and containment to prevent environmental contamination due to paint chips and dust flying through the air. Commonly, plastic media blasting is performed by a professional with the proper equipment in a debris containment facility. This method is effective on most surfaces and has been shown to produce less visual damage on composite surfaces than sanding. PTI does not manufacture materials for abrasive blasting and recommends that if you are interested in using this method that you consult with an experienced contractor.

The third method of stripping the paint from your aircraft is chemical stripping. PTI manufactures three products that for this method, **CAMA™ (PTS-294 to MIL-SPEC 81294D -TYI & TYII. CL. 2A, LYFT-OFF™ (PTS-202 to MIL-SPEC TT-R-29184 – TY I.) and XTREMESTRIP™ (SDT-110).**

- Chemical Stripping demands proper masking to prevent damage to components sensitive to abrasive chemicals. Standard masking tape and paper will not suffice. Use **only** tape and masking material that can hold up to chemical strippers or media blasting. Mask rubber parts, silicone, glue, adhesive, plastic, composites and electronic or avionic components like radar equipment and antennas. Seal all openings – windows, windshield frame, composites, vents, static ports, rubber seals, tires and flight controls. All openings are sealed. A similar procedure should be followed with other equipment. Once stripped, the substrate should be cleaned and rinsed with fresh water. Masking materials are then removed.

- A. PTS-202 – Lyft -Off™** is PTI’s “environmentally friendly,” hydrogen peroxide paint remover – with a neutral PH. It is biodegradable, contains no HAPS (Hazardous Air Pollutants), chlorinated components, is non-acidic and is considered non-hazardous for shipping purposes. Even though this type of paint remover is considered non-hazardous the paints that you are removing are not. Therefore, all materials still need to be contained. This product was specifically formulated to remove all aircraft paints and primers. Application should be performed with an airless spray system that is meant for high viscosity chemical materials. However, you may also brush, roll or dip this product provided that you achieve a consistently thick coat (3-4 mils) over the entire painted surface. The stripper will easily cling to the aircraft underbelly, vertical and horizontal surfaces. **PTS-202 – Lyft -Off™** works by breaking the bond between the primer and the substrate lifting the primer and topcoat as a single film. This process generally takes 4-10 hours. The time may be reduced by gently scoring the painted surface thereby allowing the remover to get under the paint.

PTS-202 – Lyft -Off™ differs from Methylene Chloride based paint removers because it does not reduce the paint to a liquid state. This makes the final removal of the paint and primer easy to clean up with a pressure washer or squeegee. When used according to the technical data, this product should not cause negative effects such as hydrogen embrittlement, immersion corrosion or sandwich corrosion. Additionally, this product complies with EPA rules on emissions. **PTS-202** can be used on steel, aluminum, magnesium, titanium, composites, fiberglass, ceramic, concrete, stone and wood.

- B. CAMA™ – PTS-294** is a Methylene Chloride based paint remover that is intended to efficiently remove most high performance coatings in 15 to 30 minutes after the application. When using this product, take special care to mask EVERYTHING that is not metal or painted metal. **PTI-PRG** will soften plastics, composites, rubber and similar materials. This product is considered alkaline and will not cause negative effects such as hydrogen embrittlement, immersion corrosion or sandwich corrosion when used according to the technical data.

You can apply **CAMA™ – PTS-294** with an airless spray system, brush or roller (3-4 mils thickness). The paint remover shows excellent clinging ability to the belly of the aircraft, vertical and horizontal surfaces. After the paint has lifted you should then scrape the paint off with a squeegee. Once the paint has been scraped off you will find bits and pieces that are usually in seams or located around rivets. For these areas we suggest using a wire brush to remove those coatings. When you are confident that all the paint has been removed from the aircraft, pressure wash the surface of the aircraft. It is very important to contain all the liquid chemicals and run off and dispose of it as hazardous waste at an approved facility.

- C. XTREMESTRIP™ (SDT-110)** is a Methylene Chloride based paint remover best use on parts where dipping is the best method for stripping parts.

5. Surface Preparation

Surface preparation is by far the most important and time consuming phase of the painting process. For your safety, PTI recommends that PPE such as gloves, goggles, protective clothing and a mask be used to minimize exposure to chemicals, dust and to impact from debris. From this point forward, all safety equipment should be worn especially the gloves to prevent surface contamination and the transfer of oils or other debris and to prevent chemical exposure. All dust should be removed from the surface being painted, from the floor and surrounding area immediately before and after performing any work on the aircraft surface. The following functions should be performed in a clean well ventilated area with temperatures ranging from 60° to 100°F. For metals all rust and/or corrosion should be completely removed. Section “B” discusses the various methods of accomplishing rust and corrosion removal.

- A. Composite Filling, Sanding and Surface Preparation:** The process to prepare the composite substrate is a two stage process that is always affected by the quality of the molds used to create the structure and the percent solids of the resin. The first step is to insure the shape and contour of the surface with filler. Next, perfect and sand smooth the surface for paint.
- **DON'T:** look for the low spots in the substrate individually. Trying to find them all and fill them, then sand, then recheck and refill again and again and again is time consuming and will not produce the desired result.
 - **INSTEAD:** fill the entire surface. For example, imagine that you are filling and sanding a fuselage. Start by filling the entire surface all at once by applying a fairly thick coat. After this is accomplished you can begin sanding. The amount of filler to sand off may seem overwhelming but when using the right techniques and equipment this task will seem effortless. Instead of looking for the low spots to fill, sand until you see the high spots show through the filler.

For those of you painting composite planes with deep depressions where spars or deep joints are located, fill those areas prior to the previous step. This first fill must stay below the surface of your substrate.

- To make this process easier: prior to filling, paint the aircraft's surface with a high quality dark paint (the paint needs to be high quality to prevent peeling later on). The purpose of this step is to help identify the original surface that you filled when it starts to show through during the sanding process. This also helps to prevent over sanding which can cause flat spots. While this step is not necessary, it is helpful. Once filling is complete you can begin the sanding process. Here, as with so many projects, the correct tools are imperative. There are two fundamental steps to achieving a perfectly smooth composite surface.
- First, you must have the right size and shape sanding tools for the job. An orbital sander is ideal if you can afford one. You will save yourself hours of sanding with this tool. If you are sanding by hand, you will need multiple types of tools. Different shaped surfaces require long and short boards, blocks and tubes. Sanding with paper and your bare hand will not produce the desired results.

- Second, you must have the proper technique. Make sure to sand at 45 degree angles and use the longest strokes possible, within reason. The sand paper grade you will need is 36 grit for most of the job. Follow the 36 grit sandpaper with 80 grit sandpaper to remove deep scratches. Finish with 120 or 240 grit to smooth the surface in preparation for the sandable primer application.

Once you have completed the sanding process it is important to remove all the dust from the surface, floor and surrounding area. Start by thoroughly rinsing the surface with an approved cleaner such as PTI's **PT-2001C (to MIL-PRF-85570D TY II – QPD)**. This is a non-toxic, zero VOC cleaner that is on the Navy's Qualified Products Database.

The purpose of this step is to remove large debris and to remove oils and other surface contaminants that might undermine the adhesion of the primer to the substrate. PTI also recommends the use of a solvent such as Acetone or IPA (Isopropyl Alcohol) to wipe down the plane, to insure that all oils, greases, adhesives and contaminant films are removed. For the wipe we suggest low lint wipes for smooth surfaces and abrasive surfaces from Kimberly Clark. Currently PTI packages a number of wipes kits sold through Aircraft Spruce that can include your choice of solvents and/or 0 VOC cleaners/degreasers.

When the surface is fully dry you are now ready to remove the small dust and debris particles with a tack rag or cheese cloth. When you remove the cloth from the packaging, unfold it completely. Fluff it and very lightly crumple into a very loose ball and gently graze the surface of the substrate to clean the surface. Making the cloth into a loose ball makes the rag easy to hold without pressing it or dragging it against the surfaces. Pressing the cloth to the surface will leave adhesives behind, which will undermine adhesion.

After you have created a smooth surface, you are ready to start priming with PTI's sandable Epoxy Primer (**PT-573 Light Gray**). This is an epoxy based, high build, primer designed to both fill small pin holes and correct other imperfections in the surface. Unlike most acrylic urethane based primers that are very soft and easy to scratch or dent, **PT-573** is hard and durable. For more information with regard to the use and application for the sandable Epoxy Primer refer to section 10 of this manual and to technical data.

B. Rust and Corrosion Removal for Metal Surfaces: For steel, aluminum magnesium and most other metals it is important to remove any rust or corrosion from the surface. There are several ways to do this.

- Chemical cleaners intended remove rust and corrosion are popular. You spray or wipe these products on the surface and then scrub them off. When scrubbing the metal surface use an abrasive material such as scotch brite pads. This removes rust and corrosion from affected areas and scuffs the surface all of which promotes adhesion of coatings.

- Sanding is another method used to prepare the surface. Sand the surface with aluminum oxide sandpaper which can be purchased through 3M and a number of other manufacturers. For light to moderated rust, use sandpaper with 80 or 100 grit. Once the rust has been removed, sand down the area with 240 or 320 grit sand paper to smooth the area. Excessive rust may require the use of a chemical process to remove the corrosion/rust before sanding. Particularly difficult corrosion may require additional cycles of chemical cleaning and sanding until you have a clean metal surface. Also, this is the best method for removing excessive rust on thinner metals.

Finally, blasting the surface with some sort of media can be an efficient way to rid your metal surface of rust and corrosion. Make sure that when you use this method, you follow the instructions with regard to the type of media and the equipment. Beware of blasting thin metal. Even without excessive rust, it is possible to blast through the substrate. Blasting through the substrate can occur if the blast nozzle is pointed at one area for too long a period of time and/or using excessive pressure.

- C. Metal Surface Preparation:** Whether starting with new, clean, metal or refinishing old metal, where all the corrosion and/or rust has already been removed, it is important to thoroughly wash the surface with an approved cleaner such as PTI's **PT-2001C Cleaner/Degreaser**. Repeat the cleaning process described above. When this step is complete you are ready to move to "Metal Pretreatment" where we discuss the application and benefits of using an Acid Etching Wash Primer.

6. Recommended Coatings

A. Primers: PTI has formulated all of its primers to meet the durability, adhesion and corrosion prevention requirements of the military, commercial and general aviation industries. Mix all components thoroughly before applying. This will insure that all pigments and solids that have settled to the bottom of the can will be brought into suspension and distributed evenly throughout the paint. For this task, PTI recommends placing the can on a mechanical shaker for a minimum of 15 minutes. Once shaken, open the can and with a stir stick scrape the bottom of the can to make sure that all the solids are fully dispersed. If there is still material on the bottom continue to stir the paint and scraping the settled material from the bottom of the can. Place material back on the mechanical shaker for another 10 minutes and recheck.

- Metal Pretreatment/Acid Etching Wash Primer:** PTI's Acid Etching Primer meets and exceeds the following specifications **MIL-C-8514C and DOD-P-15328D. PT-402** comes in yellow and green. It is a polyvinyl resin with phosphoric acid. When applied as a thin film, it etches the metal and promotes adhesion for the Epoxy Primer. This thin film also provides minimal corrosion protection. This primer is most commonly used on aluminum, but can also be applied to steel and magnesium. Before applying the Acid Etching Wash Primer, be sure that you read the technical data thoroughly and prepare the substrate according to the instructions in the "Metal Preparation" section. This is a two component primer, comp. A is the paint and comp. B is the catalyst. The proper mix ratio is 4 parts comp. A to 1 part comp. B by volume. Stir the two components together thoroughly. Then, reduce or thin, the admixed material by adding our proprietary solvent blend **PT-1045**. Add 2 to 3 parts **PT-1045** for every part of admixed primer – by volume. The viscosity of the admixed material should be water thin. The Acid Etching Wash Primer should be applied very thin so that you can still see the substrate through the primer.



The Panel on the left is an example of what happens when the Acid Etching Primer is applied too thick. Thick coats of an etching primer will crack, turn brown, and peel off. The panel on the right is an example of how the surface should look. The Acid Etching primer is thin, translucent, allowing you to see the substrate through the primer. Notice the black line on the panel on the right. That line was put there prior to the application of the Acid Etching Wash Primer. This primer will be dry in 5 to 15 minutes after application and the substrate is ready to be primed almost immediately after application. Unlike Alodine, rinsing the surface after application of the acid-etch primer, is not required and not recommended. After the Acid Etching Wash Primer is applied, simply move to the next step of applying a primer. Any PTI Primer may be applied over the Acid Etching Wash Primer.

- **Zinc Chromate Primer:** PTI's yellow and green Zinc Chromate primer is an Alkyd based, single component, general purpose primer that was originally formulated to meet the **TT-P-1757 (PT-522)** military specification. The Zinc Chromate is a non-sanding primer that is compatible with PTI single component topcoats such as enamels, lacquers, waterborne polyurethane and waterborne acrylic lacquer. It is intended for use over metals that are bare, scuffed, sanded, lightly rusted, media blasted and previously painted surfaces. It is an excellent adhesion promoting primer with superior anti-corrosion properties. The Zinc Chromate works by forming a passive layer that prevents corrosion when moisture in the air causes the Zinc Chromate to react with the metal. The Zinc Chromate primer can be thinned for spray application – 8 parts primer to 1 part thinner. Use either acetone or PTI's proprietary thinner **PT-1022x66**. When spraying this primer, apply 0.6 to 0.9 mil thickness to the substrate. Although, formulated and intended for metal surfaces, this primer can also be applied to wood, composite and concrete ceramics. This primer is available in bulk (pints, quarts, gallons) and in aerosol.
- **Zinc Phosphate Primer:** PTI's gray Zinc Phosphate primer (**PT-522NC**) is an Alkyd based, single component, general purpose primer. It is a less hazardous alternative to the Zinc Chromate primer. This primer has many of the same characteristics as the Zinc Chromate: it is a non-sanding, rust inhibiting and displays excellent adhesion properties. The Zinc Phosphate primer can be thinned for spray application – 8 parts primer to 1 part thinner with either acetone or PTI's proprietary thinner **PT-1022x66**. When spraying this primer apply 0.6 to 0.9 mil thickness to the substrate. This primer can be applied to most any surface including, metal, wood, composite, concrete, ceramics and more. Compatible topcoats for this primer include PTI's enamels, lacquers, waterborne polyurethanes and waterborne lacquers. This primer is available in bulk (pints, quarts, gallons, etc.) and in aerosol.
- **Water Reducible Epoxy Primer:** PTI's light green and dark green low VOC Water Reducible Epoxy primer (**PTW-582**) is a TUF/Film epoxy that has been formulated to meet and exceed **MIL-PRF-85582** and is on the Navy's QPD (Qualified Products Database). This primer exhibits excellent adhesion and inhibits corrosion on plated and bare metals but can also be applied to most any material. The Water Reducible Epoxy primer is a 2 component product that has a mix ratio of 4 parts comp. A (primer) to 1 part comp. B (catalyst) by volume. After mixing both components allow the admixed material a 45 minute induction time before reducing with distilled water. Once the primer and catalyst have been mixed you have a 6-8 hour pot life. To reduce the product for spray application, add 1 to 2 parts distilled water by volume. Do not reduce this product more than 2 parts by volume. Be sure that you **use distilled water only**. Minerals and contaminants found in tap water can compromise the primer's performance. The advantage to using a water reducible primer is that you get all the benefits of our solvent based epoxy primer without the hazards associated with the solvent. You can apply this primer by spraying, brushing, rolling or dipping. Apply the Water Reducible Epoxy primer 0.6 to 0.9 mil to the substrate. Once the product has been applied you can apply the topcoat in 1 hour or when tack dry. Do not allow more than 72 hours to allow the primer to fully cure before applying the topcoat or you will need to lightly sand or scuff the primer prior to painting. If you are sanding PTI recommends using a minimum 320 grit sand paper. If you scuff then we recommend scotch brite pads.

More experienced painters will actually wet sand with 400 or 600 grit sand paper to achieve the “ultimate” finish. For inexperienced painters applying the topcoat over such a smooth surface can be problematic. The Water Reducible Epoxy primer is an excellent primer for interior and exterior applications and is compatible with any PTI topcoat and most other topcoats. When spraying the Water Reducible Epoxy Primer do not spray any other paints or expose the paint to any foreign solvents or vapors to avoid contamination.

- **Epoxy Primer:** PTI’s low VOC Epoxy Primer (**PT-500 yellow, green, BAC377 and BAC452**) is a high solids epoxy primer that meets and exceeds **MIL-PRF-23377 Revisions E – K TYI & TYII Class C, C2 and N** and is on the Navy’s QPD (Qualified Products Database). PTI’s two component catalyst cure high solids epoxy polyamide primer cures to an extremely hard impervious film which resists yellowing and chalking. The primer has some of the same resistance properties as urethanes with much higher adhesion characteristics. It provides the ultimate protection and gives a high quality finished appearance to metal, wood, composites and most other materials able to be coated. The Epoxy Primer that is sold through Aircraft Spruce is the E revision with a mix ratio of 1 to 1. To spray, thin, or reduce, 10% by volume with **PT-1003 TYII**. (**Note: All revisions of this specification are available through Aircraft Spruce upon request. Including Revision K – with and without chromate PT-500K TYI Class N**).

The Epoxy Primer is able to be applied directly to composite and metal surfaces that have been prepared and cleaned properly. However, when applying to a metal surface PTI recommends using the PT-402 Acid Etching Primer to promote long lasting adhesion. After you have applied the Epoxy Primer you have approximately 72 hours to apply PTI’s Polyurethane before the Epoxy Primer fully cures. Once the primer has cured you will need to scuff the surface with a scotch bright pad or 320 grit sandpaper. More experienced painters will wet sand with 400 or 600 grit sand paper to achieve the “ultimate” finish. Inexperienced painters may find that using such a fine grit makes applying the topcoat problematic because the surface is so smooth. If you are using the Epoxy Primer that has a 1 to 1 mix ratio you are using the E Revision, in which case you can apply the Polyurethane topcoat after allowing the primer to become tack dry, usually 1 to 4 hours depending on the surrounding temperature. If you are using one of the newer revisions such as the non-chromate K revision that has a 3 to 1 mix ratio then you will need to let the primer dry for at least 5 hours or tack dry before applying the Polyurethane topcoat. For more information with regard to the Epoxy Primer and the various revisions and types please contact PTI directly and refer to the technical data for the PT- 500 Epoxy Primer series. This primer is compatible with any PTI topcoat and most other topcoats.

- **PTI's Sandable Epoxy Primer:** The Sandable Epoxy Primer (**PT-573**) is a high build primer commonly used as a filler primer specifically for composite aircraft. The **PT-573** has the same protective and adhesion promoting qualities as the Epoxy Primer. This Primer is meant to be applied 2 to 4 mils thick and sanded smooth. Making a smoother, seamless and blemish free finish easy to achieve, with the application of the. Please read the technical data thoroughly prior to applying this product.

The Sandable Epoxy Primer is a two component product that needs to be shaken thoroughly – 15 to 20 minutes – prior to mixing the individual components together. Do not thin or reduce this product unless completely necessary. The recommended thinner/reducer is PTI's proprietary solvent blend PT-1002. The most efficient way to apply this product is to first spray a fog or tack coat to the substrate and let it dry for 30 minutes. Follow the tack coat with thicker coat of 1 to 2 mils. For dry and cure times please refer to the technical data.

Wait at least 8 hours after applying the paint before sanding. You will need three kinds of sandpaper – 180, 240 and 320 grit. First pour water onto the surface and use a squeegee to remove the excess water. All remaining pits will become instantly visible. And, if you did all the prior steps properly, you should not find very many. Continue by lightly sanding or scuffing the pitted areas and checking for more trouble spots, marking them as you go. **DO NOT** attempt to sand away remaining flat spots or dips. Instead, use a polyester glazing putty to fill the flat spots, dips and nicks. You can find polyester glazing putty through Aircraft Spruce or your local paint shop. Before this final fill however, inspect the entire surface again for imperfections and mark them with a pencil. Mix the glazing filler in small batches – it has a very short pot life. You only have a few minutes on each batch. Finally, squeegee the glazing putty on with a small metal spatula and scrape off the excess. After this final fill has cured, sand the entire surface with 320 grit, or finer, sand paper. You are now ready for your topcoat. More experienced painters will sand with 400 or 600 grit for the “ultimate” finish. This Primer is compatible with any PTI topcoat and most other topcoats.

- B. Topcoats:** PTI's topcoats, much like our primers, have been formulated to meet requirements of the military, commercial and general aviation industries. However, with topcoats we concentrate on weathering, UV protection, adhesion, chemical resistance and impact resistance. All of our topcoat colors are tinted from a white or color base as opposed to a clear base. What that means for our customers is that the product has optimum “hide.” Therefore, fewer coats of paint are required. This means less weight on the aircraft. All of our topcoats are available in flat, satin, semi-gloss (single stage) and high gloss (single stage). PTI's color book is the 595C Federal Color Standard. However, custom color matching including aluminum and gold metallic as well as pearlescent pigments are available at no additional charge.

Before topcoat application, it is important to thoroughly shake and then mix all components. Performing this task properly will ensure that all pigments and solids that have settled to the bottom of the can will be brought into suspension and distributed evenly throughout the paint. For this task PTI recommends placing the can on a mechanical shaker for a minimum of 15 minutes. Next, open the can and with a stir stick scrape the bottom of the can to make sure that all the solids are fully dispersed. If there is still material on the bottom continue to stir the paint and scraping the settled material from the bottom of the can. Place the material back on the mechanical shaker for another 10 minutes. Check again before using.

Waterborne Polyurethane: PTI's Waterborne Polyurethane is a low VOC single component product that has been formulated for application on the interior of an aircraft and as an exterior touch up paint. This paint was formulated to meet and exceed **MIL-PRF-81352C TYIII (PTW-170)**. Our Waterborne Polyurethane has the lowest VOC (under 70 grams per liter) of any topcoat in the aviation industry making it one of the least hazardous. Do not let the low VOC's fool you. This paint has been tested extensively to insure excellent chemical resistance, weathering capabilities, adhesion and impact resistance. To reduce this product use distilled water only. Reduce 10 parts of paint to 1 part distilled water by volume. Do not reduce more than 10 to 1 by volume or you will negatively affect the performance and appearance of the coating. As with most waterborne coatings, proper application and an awareness of the environmental conditions in which the coating is being applied are extremely important. PTI recommends applying this coating in temperatures no lower than 60°F and no higher than 95°F. Do not spray when humidity exceeds 85 percent. Additional moisture can over thin the paint after it has been applied to the substrate. When spraying outside, avoid high winds and direct sun light. When applying the Waterborne Polyurethane it is best to first spray a fog or tack coat to the substrate and let dry for 10 minutes. Follow the tack coat with one thick coat at 1mil. For dry, cure and recoat times please refer to the technical data. If consistent coverage was not achieved with the 2nd coat apply a 3rd coat that is 0.6 – 0.9 mil. Before recoating the prior coat should be tacky or tack dry before you can start to spray.

To avoid contamination, do not expose the Waterborne Polyurethane to any other paint products, solvents or solvent vapors.

- i. **Enamel:** PTI's Enamel topcoats are high performance single component paint. Enamels can be used for interior and exterior application. Although, this product is most commonly used for interior and exterior touch up application. The PTI Enamel is formulated to meet **TT-E-489J (PT-381)**, **TT-E-529G (PT-382)**, and **TT-E-527D (PT-383)**. This product provides durability and protection with the advantage of easy application. Also the cost and easy of application make this paint very economical. The PTI Enamel is compatible with any one of PTI's primers. However, we recommend the Zinc Chromate or Zinc Phosphate primers due too easy of application. Before applying this paint by spraying you should reduce 8 parts enamel to 1 part reducer. You have three reducer options, **PT-1022x66**, **PT-1003 TYIII** and Acetone. When applying the Enamel it is best to first spray a fog or tack coat to the substrate and let dry for 30 minutes. Follow the tack coat with one thick coat at 1mil. For dry, cure and recoat times please refer to the technical data. If consistent coverage was not achieved with the 2nd coat apply a 3rd coat that is 0.6 – 0.9 mil. Before recoating the prior coat should be tacky or tack dry before you can start to spray.

- ii. **Interior Epoxy:** PTI's Interior Epoxy topcoat is a low VOC two component Epoxy topcoat that has been formulated to meet and exceed the requirements of **MIL-PRF-22750D & E (PT-426 Epoxy series; BMS 10-11V, Type II)**. Although this paint is intended for interior applications, the specification that the product meets does have weathering and UV requirements, making it the most durable and impact resistant coating, that will resist yellowing, to use in your cockpit. This paint is only compatible with other two component epoxy primers such as the PTI's Water Reducible Epoxy, PT-573 Sandable Epoxy and Epoxy primers. Since this is a two component coating you will need to mix 2 parts paint to 1 part catalyst by volume and allow a 15 minute induction before reducing and/or application. To reduce this product for spray application you must use **PT-1003 TYII** 10% by volume. Reducing more than 10% will over thin the material and potential cause runs or drips in the finish coat. When applying the Enamel it is best to first spray a fog or tack coat to the substrate and let dry for 30 minutes. Follow the tack coat with one thick coat at 1mil. For dry, cure and recoat times please refer to the technical data. If consistent coverage was not achieved with the 2nd coat apply a 3rd coat that is 0.6 – 0.9 mil. Before recoating the prior coat should be tacky or tack dry before you can start to spray.
- iii. **PTI Polyurethane:** PTI's Polyurethane topcoat is a unique formulation of high molecular urethane resins which produce an extremely hard impervious film which will not yellow or chalk and retains gloss even when exposed to most solvents, chemicals, fumes and sun light. This coating can be applied to most any surface and is a new age high solid polyurethane system has an average of 79% of solid material per admixed gallon. When mixed properly, PTI's polyurethane covers 20% more than most other high solid urethanes on the market. It also has a gloss range of 95 degrees and higher, which ranks this coating among the highest in the industry. PTI's Polyurethane meets **MIL-PRF-85285, Rev. E Type 1, Type II and Type IV (PT-799)** as well as customer specifications for Boeing, Douglas and Embraer Air. As previously stated, this coating is flexible, long lasting and very durable. The coating itself dries very hard and provides a high gloss finish while maintaining a chemical resistance which is unmatched. The Polyurethane is a two component system, with a 1 to 1 mixing ratio by volume. Every batch of our Polyurethane has UV inhibitors for added weathering protection. PTI also offers its customers the option to request custom colors including aluminum and gold metallic at no extra charge. When applying high gloss the polyurethane will appear to have the reflective properties of a mirror when applied correctly. We achieve this in part through a superior resin system and pigments. The results achieved through our manufacturing process and the correct application of the Polyurethane is colors that are more clear and vivid. Unlike the polyurethanes from other manufacturers, **PT-799** maintains its flexibility without plasticizers. Plasticizers are an additive used to promote flexibility but they are the first part of the coating to fail due to exposure to heat and UV rays. The Polyurethane should only be applied over an epoxy primer. Application over single component primers such as the Zinc Chromate or Zinc Phosphate will lift the primer.

When applying the Polyurethane it is best to first spray a fog or tack coat to the substrate and let dry for 30 minutes. Follow the tack coat with one thick coat at 1mil. For dry, cure and recoat times please refer to the technical data. If consistent coverage was not achieved with the 2nd coat apply a 3rd coat that is 0.6 – 0.9 mil. Before recoating the prior coat should be tacky or tack dry before you can start to spray.

7. Application Methods

- A. Dipping:** Dip application is a process that is commonly performed when there are a large number of small parts to coat. This is a process requires a tank that allows you to fully submerge the part in the coating. Once the part has been removed from the dip tank it is recommended that you hang the dipped part from racks with tie wire until dry hard. This application is most popular with primer type coatings but can also be performed with topcoats.
- B. Brushing:** Brushing is most commonly used as a method of application for painting small touch up areas or when applying paint in confined and enclosed spaces. Before you begin to apply you should confirm that the brush is compatible with the paint that you are applying. For example if you are applying a solvent or oil based paint, be sure that the brush is not intended for water based or water borne coatings. Now that you have confirmed that you are using the correct brush, review the technical data. Specifically you are looking for reducing instructions with respect to brushing. For most PTI products, the paints come ready to brush (no reducing required). Our reducing instructions commonly apply to making the products “spray ready”. A good way to identify if the material is too thick or thin is to first brush the paint on a small test panel. If the paint is too thick the material will either pull or rope under the brush. This means that you will see the lines and ridges from the brush on the surface of the paint. If the paint is too thin the material is likely to not cover well, run and/or drip. Proper viscosity and substrate temperature ($75^{\circ}\text{F} \pm 5^{\circ}\text{F}$) allows the material to flow out and eliminates marks left by the brush.
- C. Spraying:** Spraying is the most common and most preferred method to achieve the best finished product over large and small areas efficiently. All spray systems have the same basic characteristic. There must be a sufficient amount of air whether from a piston type compressor (conventional spray system) or from a turbine more commonly used on HVLP systems (High Volume Low Pressure). Next you need a pressure pot, tank, reservoir or cup to house and supply the paint material. Finally, you a gun or device that properly applies the paint to the substrate allowing the user to control the air low and the volume of paint leaving the gun so that the paint is atomized into a consistent spray or cloud so that a smooth finish to be achieved. Conventional spray systems need water traps and oil filters incorporated in the air supply line to remove moisture and contaminants. Traps and filters must be maintained to work efficiently.
- i. **Aerosols:** Although this section is meant to mainly discuss conventional spray systems and HVLP I would like to touch on aerosol cans which have all of the characteristics listed above. The propellant in the can is the air supply, the can itself is the reservoir and the valve and nozzle is the application device. However because of the small amount of paint that aerosol cans hold they are commonly used on small parts and touchups. We also find that paints packaged in aerosol cans are usually single component products such as lacquers, enamels, alkyds, etc. Painting an aircraft exterior with single component paint should be limited to touch up. It is possible to obtain two component materials in an aerosol can through 2 different methods. First you can order product, i.e. epoxies and polyurethanes, in a can intended for two component material. These cans require you to pop a valve on the bottom of the can to release the catalyst into the paint. These cans have a short shelf life, pot life and are very expensive for the amount of material inside the can. The second is a solution that PTI provides for applying two component paints and coatings from an aerosol can. The aerosol cans come as a kit, with a plastic bottle

and pump. The aerosol can contains the paint (component A) and the plastic bottle contains the catalyst (comp. B). You first shake the aerosol can thoroughly and should hear the bearing rattle inside the can. Next you screw the bottle of catalyst onto the hand pump, remove the nozzle from the top of the aerosol can and snap the pump to the top of the can. After the pump is securely attached pump the catalyst into the can. Once all the catalyst is in the can, detach the pump and reattach the nozzle and shake well for 5 – 10 minutes. You are now ready to apply the product. Both of the methods for applying two component products from an aerosol can are limited to a single use and should be sprayed with in 4 to 8 hours of adding the catalyst to the paint, depending on the technical data sheet.

- ii. **Conventional Spray System:** Now back to our discussion with respect to a conventional spray system. There are a few types of equipment for this system pressure feed, gravity feed and siphon feed. Conventional spray equipment is usually applied by using a compressor to supply air at 20 to 50 PSI depending on the gun. The size area that you are going to paint will determine what kind of material container and/or gun you will be using. For small parts, small areas or trim you may want to use a gravity-feed or siphon feed gun. Gravity and siphon feed guns have an integral paint container usually holding up to 1 quart or 32 ounces of material. The container can be mounted on top of the gun which is a gravity feed or underneath where the paint material is fed to the tip and nozzle of the gun with air pressure from the compressor or siphon feed. Gravity-feed guns, as stated earlier, have the paint supply cup mounted on the top of the gun. The operator can make fine adjustments between atomizing pressure and fluid flow and use all the material in the cup. This is also an internal mix gun. The siphon feed gun is a conventional device that is familiar to most people. Regulated air passes through the gun and draws the paint from the supply cup. The fluid and air mix outside of the air cap atomizing the material, which like the gravity-feed makes this an external mix gun. These options are usually reserved for small areas or when painting trim. For applying paint to large areas you will want to use a pressure feed equipment with a large container or pressure pot (2 quarts to 60 gallons) that feeds material and air to the gun. Pressure feed is more desirable in this circumstance since a large amount of paint can be applied to the substrate without interruption of stopping and refilling the pressure pot. Also, without a container mounted on the top or bottom of the gun itself the applicator does not have to deal with as much weight and has the flexibility to spray in any direction with constant pressure through the gun.
- iii. **HVLP Systems:** The HVLP system is a newer technology which is becoming the preferred method of application due to more restrictive EPA regulations. The air supply system itself is completely different from the high pressure convention type spray system which is fed air with a piston type compressor. The HVLP air supply is provided through a series of turbine fans or stages that move a high volume of air at a low pressure. The more stages or fans that you have provide a great volume of air output which is rated in CFM's (cubic feet per minute). Before entering the turbine fans the air is filtered to remove dirt, dust and debris. A second filter comes after the turbines on the air output side to supply the spray gun. Unlike the piston type compressor system the HVLP does not produce water or oils that can possibly contaminate the air supply.

The down side is that the turbine heats up, causing the paint to dry faster. To avoid this you can get an extra length of hose to reduce the air temperature at the spray gun. Just like with the conventional spray system you can use a gravity-feed and siphon feed spray guns and use a pressure pot or pressure equipment for large areas. However, HVLP guns are considered internal mixing guns. This means that the air and the paint are mixed inside the air cap. Also, HVLP systems have the advantage of low pressure in the paint application. The advantage is the amount of paint transfer to the substrate. HVLP spray guns can transfer 65 to 80 percent of the material to the surface.

8. Masking

When painting the bulk of the aircraft surface with one color (usually white) very little masking is needed initially. However, it is necessary to mask the cock pit, windows, window trim, wheels, vents, openings, lights antennas and anything else you do not want painted. If you come to a seam, opening or an area that you do not want painted and are not sure if you should mask it, mask it anyways. PTI recommends masking with good quality solvent resistant masking tape that is at least 1inch wide and that you use good quality masking paper when covering larger areas such as windows, wheels, propellers, cock pits, etc. Do not use news paper to mask or low quality tape. For large openings or gaps it is helpful to stuff them full of crumpled up paper prior to masking. Newspaper with transfer ink to the surface and low quality tape will leave adhesive residue behind when the tape is removed. When applying the tape to the surfaces you would like masked take extra time to ensure that you have achieved a good seal by pressing down the edges. When you wrap items with paper, make sure to seal every possible opening with tape to prevent paint from finding its way where you don't want it.

9. Painting Sequence for Single and Twin Engine Aircraft

When spraying an aircraft or any surface, using a cross spray technique is recommended to achieve consistent and complete coverage. Cross spraying is when you spray each coat in a direction perpendicular to the previous. Apply the primer coat followed by spraying a tack coat and subsequent topcoats with a cross spray technique, one coat vertical followed by a horizontal coat.

Start spraying the corners and gaps around fixed and control surfaces. Then paint the leading edge and trailing edge of every surface. If applicable, spray the landing gear and wheel wells followed by the belly of the fuselage and up the sides to the horizontal break. Paint the underside of the horizontal stabilizer, the vertical stabilizer and rudder. Once complete paint the topside of the horizontal stabilizer. Spray the top and the sides of the fuselage down to the horizontal break over lapping the spray from the underside. Finally, spray the underside of the wings followed by the top of the wings.

Although, painting a small aircraft is very possible with one experienced applicator PTI recommends having 2 painters working simultaneously. A challenge that applicators face when working by themselves is controlling the overspray and keeping the applied paint wet so that you have a consistent smooth finish over the entire aircraft as you paint the various sections.

10. Masking for Trim

At this point in the painting process the aircraft has been painted with a based color over the entire surface. Carefully remove all masking paper and tape from the painted surfaces. Now you are ready to start prepping to mask for trim paint application. Before applying any tape make sure that you refer to the technical data to make sure that the paint is dry and cured enough to reapply tape to the surface. For the Polyurethane you should wait a minimum of 24 hours, 36 hours is optimum. If you apply tape to the area any sooner you risk pulling up the previously coated area. Do not wait for more than 72 hours otherwise you will need to scuff the areas that are to be painted.

Trim designs can be elaborate with multiple color schemes and designs or they can be simple with just 2 or 3 colors. Either way the masking should be done the same basic way. There is no shortage of websites and databases that show you exactly how to lay out the design like a professional.

Making your own personally designed paint scheme is an option. If this is the route you are taking you should draw the design on a silhouette drawing of the aircraft that is as close to scale as possible. I have found that changing a drawing is much easier then to re-mask.

The masking materials you should use for the trim lines are 3M Fine Line tape. This tape is solvent resistant and is available in widths that range from 1/8 to 1 inch and give a good clean edge when applied properly. Quality masking tapes such as the product from 3M and masking paper should be used to cover the areas that you do not want to trim to avoid the paper lifting and overspray the basecoat.

To start the masking you must first set a point on the aircraft from which to initiate the trim lines using the 3M 1/8 or 1/4 inch Fine Line tape. If the lines that generate from this point have a large radius or are straight use the 3/4 inch or 1 inch tape. Keep the tape pulled tight with one hand will pressing the edge with the other. I have found that it is much easier to control wider tape when masking a radius that does not turn to sharply as well as straight lines. Sharp and short radius curves require the 1/8 inch or 1/4 inch tape to avoid crinkles in the tape. The key is to use the widest tape possible that will lay down flat around a radius. On one side of the plane, finish masking the fuselage, wings, vertical fin, rear stabilizer, rudder and the engine nacelles. At this point any adjustments that need to be made should be made, examine the lines very carefully.

After one side of the aircraft has been completed, trace the entire design on paper and transfer the design to the other side of the aircraft. Be sure that you pick the same starting point as you did on the other side. Also to ensure that your angle is the same, pick a few points on the side of the aircraft that is already masked and use them as points of reference to make sure that your lines and points are even.

Of course different methods can be used to transfer the placement of the trim design. Another method is to use the initial starting point and apply trim tape using the rivets or metal frames to measure and position the tape correctly. After both sides are done being masked take a picture, inspect for differences and make corrections where needed.

Now that the taping is complete, PTI recommends that you apply a sealing strip of 3/4 inch tape covering half the Fine line tape extending over the outside edge. Applying a thicker tape gives you a larger area to tape the masking paper to with 1 inch tape. Be sure to place half the masking tape to half the width of the tape that has already been applied and the other half to the masking paper. Now that all the trim masking is complete, it is important to mask around that area to prevent any overspray from landing on the base color coat. To ensure that paint does not drift under the masking paper or tape, check your seams and double check the edges by pressing them to the substrate.

11. Common “Painting” Problems

Painting is a skill. An experienced painter knows what environmental conditions are ideal for spraying and what conditions to avoid. Factors to consider are temperature, humidity and wind. So before you paint, familiarize yourself with the technical data for the products that you will use. It is common to attribute a painting problem to the paint. As difficult as it may be to accept, most times what is thought of as a “paint” problem is a “painting” problem. Painting is a process that demands the painter to control a number of factors – the mixing of the paint, the cleaning of the gun and its lines, the environment in which the painting occurs. Failure to control those factors can result in painting problems. Those problems are noticeable and include: poor adhesion and lifting, blushing, sags, runs, drips, orange peel, solvent pops or pinholes, fisheyes, sanding scratches, dings, dents, wrinkling and dry spray. **Before you ever pull the trigger of your spray gun** to paint your aircraft you should test your paint mixture, gun settings and environmental conditions to assess the affect of those things on the quality of the paint job. Use the test to dial in the fluid volume, air supply, spray pattern and try to figure out the appropriate distance from which to spray the substrate (8-10 inches). It is also important to test the speed at which you should move the gun across the substrate.

A. Adhesion and Lifting: If the adhesion of a product fails it is usually due to poor or improper cleaning and preparation of the surface to be finished. Using the wrong primer for the substrate can also cause adhesion failure. Incompatibility of the topcoat with the primer can cause failure especially where the solvents in the topcoat undermine the primer and cause the primer to lift. If an improper thinning or reducing of the material occurs, the paint can dry too quickly and lift. If the wrong thinner is used the performance and adhesion properties of the material could be compromised. When materials are mixed improperly, for example mixing an epoxy catalyst with and polyurethane base, adhesion will most certainly fail. Finally if the spray equipment or fluid and air lines are contaminated, then water, oils or other materials can affect the adhesion properties. Unfortunately, the only way to correct poor adhesion is to completely remove the finish. After which, you should evaluate what the cause was and correct the issue before entirely refinishing the affected area.

B. Blushing: Blushing is when the paint finish appears dull, milky and hazy. This effect is usually caused when the wet or drying paint traps moisture. This occurs most often when humidity is at 80% or higher. The reason that blushing forms is because when the solvents quickly evaporate from the applied coating, causing the temperature to drop enough to condense the water in the air. Other, causes for the blushing include spraying in temperatures that are blow 60°F or above 95°F, using an incorrect thinner that causes the paint to dry to fast and/or excessively high air pressure at the spray gun. Sometimes you will notice blushing while painting. If this is the case you can usually add retarder or a compatible slow drying solvent to the paint mixture, and the repaint the area. If the paint is dry by the time you find blushing then you will need to sand that area down and repaint.

C. Sags, Runs and Drips: Sags, runs and drips are more often than not a function of applying too much paint to the substrate. This happens when the spray gun is held too close to the substrate or if the gun is moved across the surface too slowly. If the paint is not reduced correctly and is too thin the paint can sag and drip easily. Also, if the fluid volume setting on the gun is too high the air supply is to low an excess of material can be applied to the substrate. Air to paint mixture settings on the gun can also cause spitting, which is when the paint is not being properly atomized into a spray or cloud. Sags, runs and drips can be avoided by reading and following the technical date thoroughly and utilizing proper spray techniques which will be discussed in chapter 14 of this manual.

- D. Orange Peel:** Orange peel is when the painted surface appears bumpy much like the skin of an orange. The orange peel affect is the product of excessive surface tension or from the product drying too quickly and not being allowed the proper amount of time to flow out properly which can be caused by a number of different scenarios the first of which is not making the proper fluid to air adjustments on the spray gun. Not using enough reducer to thin the product may result in thicker coats that will develop orange peel. If material is not mixed thoroughly and uniformly the material may be compromised as it is being applied. Force drying a coating too soon after it is sprayed or force drying a coating too quickly can prevent the product from fully flowing out to create a smooth surface. Too little flash time between coats can also cause orange peel. Please refer to the technical data for the material and read through the instructions with respect to recoat times. Finally if the ambient or substrate temperature is too hot or too cold. If you notice that the orange peel is very light then you can wet sand and buff out the imperfect according to the technical data. If the orange peel is heavy you will need to sand the area smooth and repaint. If you are concerned about environmental conditions that tend to create “orange peel” we recommend that you use our product “**NO-PEEL™**.”
- E. Solvent Pop and Pinholes:** Pinholes or “solvent pop” visibly appears on the surface of finished paint due to trapped moisture or solvents. When the very top layer of paint dries quickly while underneath the paint stays wet or “skins over”, moisture or solvents are trapped and form pockets that pop open when the fumes finally escape, creating pinholes or solvent pop. This effect can be caused by excessively hot temperatures or high winds that causes the surface of the paint to dry too fast. Contaminants in the paint or airlines can also contribute to the problem. Poor spraying techniques that allow excessively heavy or wet paint coats, which tend to trap moisture or solvents underneath the finish can also cause the problem. Lastly, using the wrong thinner or reducer, either too fast by quickly drying the surface and trapping solvents or too slow and trapping solvents in subsequent topcoats. If you do encounter this issue you should first identify what went wrong. Check your equipment to ensure that it is clean, evaluate your environment and double check your materials against the technical data. Once you have identified and corrected the problem, sand the area or areas smooth and repaint. If you are concerned about environmental conditions that tend to create “solvent pop” we recommend that you use our product “**NO-POP™**.”
- F. Fisheyes:** Fish eyes appear in wet paint or paint that is being applied as small pin holes where you can see the substrate or underlying surface. Most likely this has occurred because the surface being painted has not been prepared correctly. The only other reason would be because your lines are contaminated with water and/or oils. If you find that while you are spraying you see fisheyes, immediately stop spraying. As I stated earlier it is most likely due to surface contamination, usually the residue of cleaners, silicones, waxes or various oils have not been properly removed. Clean off all of the wet paint. Then, thoroughly clean the surface to remove all traces of silicone with a silicone wax or lubricant cleaner. The only way to truly prevent fisheyes from ever occurring is to ensure that the surface to be painted is entirely free of ANY type of contamination as well as your equipment. The “water break test” is a very effective way to check for contaminants. Grab a hose and gently rinse or spray the surface to be painted. If you can identify areas where the water beads, instead of runs, then that surface is not clean. An unbroken film of water should flow down the substrate.

- G. Sanding Scratches:** If you see scratches or sharp lines in your finish coat, then that is a good indication that the surfaces to be painted were not properly prepared prior to application. This particular issue is not indicative of metal surfaces. Rather, it most commonly occurs on non metal surfaces such as composite, wood and plastic. In rare cases you will see scratches in the finish when an overly rapid or quick drying thinner is used. The only fix for this is to sand the affected areas until smooth, repaint and repeat until the affected area is filled and a smooth finish is achieved.
- H. Wrinkling:** Wrinkling is caused by unequal drying of the finish or trapped solvents from thick or solvent heavy paint coats. If fast evaporating solvents are missed in the paint they can also cause wrinkling if the sprayed coat is not allowed to dry thoroughly. When thick coats or quick drying solvents are employed the top surface of the coating tends to dry before the coating is “dry through” trapping solvents underneath. If another coat is applied before the previous coat is dry, wrinkles may result. Furthermore, if a heavy coat is applied before the prior coat is dry enough you may lift the coating underneath, with the same effect as a paint stripper. Rapid temperature change in the surrounding environment, while applying the material, may result in the uneven release of solvents from the coating. This will cause the surface of the paint to dry unevenly, shrink and wrinkle. Making the error of using incompatible thinners or reducers can cause wrinkles among other problems as well. If the paint wrinkles you must completely remove the paint either by sanding or stripping.
- I. Dry Spray:** Dry spray is a product of atomized spray particles from paint gun flashing off or drying before being transferred to the substrate. Dry particles will not flow. They will leave a dust like material on the substrate. This effect is usually caused by too much air and not enough fluid volume flowing through your spray gun. The first step you should take when you see dry spray is to dial down the air pressure into the gun and adjust the spray pattern down. If that does not change the dry spray then increase the fluid volume. Next you should evaluate how far you are holding the gun from the substrate, 8 to 10 inches is the preferred distance. Finally if you are still having an issue with dry spray, verify that you are using the correct reducer. Fast evaporating reducers can easily cause dry spray.

12. Paint Compatibility

The use of a number of different paints and coatings along with different proprietary coatings makes repair of damage or deteriorated areas a challenge. Not all paint systems are created equal or compatible. The following list is a general guideline of what **not** to do when it comes to repair or touch-up. However, before ever performing a repair or touch-up, please contact the manufacturer of the products you will be using to verify compatibility.

- Zinc chromate can always be used for touch ups directly to bare metal surfaces and on interior surfaces. If you are planning to topcoat the zinc chromate with a two-component polyurethane or epoxy you will need to check with the manufacture to make sure that the topcoat will not lift the primer. Zinc chromate primers are usually topcoated with single component acrylics, lacquers, enamels or alkyds. You are able to use acid etching wash primers over zinc chromate primers.
- Modified zinc chromate primer must never be used on bare metals. If you would like to use a modified version you should first apply an acid etch wash primer to the bare metal. Furthermore, do not apply a modified zinc chromate primer over any acrylic nitrocellulose lacquer. There will be no adhesion.
- Nitrocellulose coating and lacquers will adhere to acrylic finishes. However, acrylics will not adhere to nitrocellulose coatings and lacquers.
- Acrylic nitrocellulose lacquers show poor adhesion when applied over nitrocellulose and epoxy coatings. To properly touch up areas with a lacquer or nitrocellulose lacquer you need to apply the material of successive coatings or an acid etch wash primer or zinc chromate primer that has been applied directly to bare metal. They can also be applied to an epoxy or epoxy primer that has recently applied (dry hard less than 24 hours).
- Epoxy coatings adhere to most any two component paint system and some single component systems that are in good condition and show good adhesion. Epoxy coatings are very useful for general touchup on interior surfaces and some exterior surfaces and especially on baked enamels.
- Old wash primer can be over coated directly provided that the initial application shows no defects. Wash primer defects occur when the coating is too thick causing a failure in adhesion.
- When touching up old acrylic with new acrylic you must first rewet the paint with acrylic nitrocellulose thinner.
- If damage to an epoxy surface occurs you must fix it with an epoxy or polyurethane. In some scenarios, an air-dry enamel can be used to touchup an epoxy surface, provided the edges of the damaged areas are abraded with fine sand paper (320 grit). Acrylics and nitrocellulose lacquers will usually not adhere to an epoxy surface.
- Polyurethane surfaces should be touched up with a two component polyurethane but can also be touched up with an air-dry enamel, acrylic lacquer, nitrocellulose lacquer, waterborne lacquer (**MIL-PRF-81352 TYI –PTW150**) or waterborne polyurethane (**MIL-PRF-81352 TYIII – PTW- 170**). Before you repair an effected area you should always abrade the surrounding surface with fine grade sandpaper (320 grit).

A. Paint Touchup: Paint touchup to the substrate and the topcoat may be required for a number of reasons. Repair to a metal or composite substrate are the most substantial touchups that usually involve not only the topcoat but the primer as well. Minor touchups usually involve repairing only the topcoat. Topcoat touchups include, but are not limited to, scratches, abrasions, permanent stains and fading. The first step to touch up is to identify what kind of coating you are going to touch up.

B. Identifying Paint Finishes: Finishes that are currently on the surface of your aircraft can be any number of different types of coatings, or a combination of two or more types, or even combinations of general paints with special proprietary coatings. Any of the previously discussed finishes may be present on the aircraft at any given time. Also repairs may have been made, utilizing a number of different coatings, without your knowledge. With that in mind, it is important to identify each finish on the aircraft to ensure that the topcoat application will properly adhere and will not lift previously applied finishes. One common test is to apply a coat of engine or turbine oil that conforms to MIL-PRF-7808 to a small section of the aircraft. Old nitrocellulose type coatings will soften within a few minutes. Acrylic, polyurethane and epoxy finishes will show no defect. If you still cannot identify the paint then soak a rag with MEK (Methyl Ethyl Ketone) and wipe the painted surface. A MEK wipe should pick up pigments from all coatings except polyurethanes, epoxies, phenolic resins and baked on coatings. Just wipe the surface, do not excessively rub or you will not get a true test. Heavy rubbing can affect some bake, epoxy and polyurethane coatings. Do not use MEK on nitrocellulose coatings.

Nitrate	Nitrate Dope	Butyrate Dope	Nitrocellulose Lacquer	Acrylic Lacquer	Acrylic Enamel	Urethane Enamel	Epoxy Paint	Polyurethane Paint
IPA 99%	IS	IS	IS	S	IS	IS	IS	IS
Methanol	S	IS	IS	IS	PS	IS	IS	IS
MEK	S	S	S	S	ISW	IS	IS	IS
Methylene Chloride	SS	VS	S	S	ISW	ISW	ISW	ISW
Toluene	IS	IS	IS	S	ISW	IS	IS	IS

- IS: INSOLUBLE
- ISW: INSOLUBLE, FILM WRINKLES
- PS: PENETRATE FILM, SLIGHT SOFTENING WITHOUT WRINKLES.
- S: SOLUBLE
- SS: SLIGHTLY SOLUBLE
- VS: VERY SOLUBLE

C. Preparing the Surface for Touchup: Now that you have identified the type of paint the surface can now be prepared. Before any work is started you must thoroughly clean the plane, removing all dust, debris, oils and dried films with an aircraft degreaser (**PTC-2001 Aircraft Degreaser**), especially if you are going to sand or abrade the area and apply paint over the existing primer. If you are going to repair a whole panel from seam to seam you will need to strip the panel completely. Repairing an area from seam to seam eliminates the need to match and blend to the topcoat to the existing color as closely as you would need to when repairing small areas. After the area is completely stripped you should be completely redone with the wash primer, epoxy primer and polyurethane topcoat. The paint along the edges of the stripped area should be hand sanded wet and feathered with a 320 grit sand paper. When repairing small areas or performing spot repair which requires blending of the new paint to the existing paint, you should plan on preparing an area three times the size of the damaged area. If the affected area has undermined the primer or is adhesion properties to the substrate then sand the area with 320 grit aluminum oxide sandpaper on a double action electronic sander. After which you should wet sand the area using the same double action sander with 1500 grit wet sanding paper. Prior to applying the wash primer and epoxy primer to the area where the substrate is exposed, wipe down the area with Acetone or IPA following by a tack cloth. When spraying the primers use the cross spray method to achieve even coverage. For the Epoxy primer please refer to the technical data for dry times and recoat

times. After the primer is dry sand the area with 1500 grit wet sand paper as well as the surrounding area, approximately three times the size of the repair. Clean and wipe with area with IPA or Acetone followed by wiping the area with a tack cloth. Mix the compatible topcoat paint according to the technical data. The first two coats that you apply should be light. The second coat should extend slightly further than the first. Allow each coat to flash off to tack dry before applying the next. After the second coat has dried sufficiently apply a third coat that has been thinned 3 to 1 with the appropriate reducer. Spray the third coat so that the coating extends past the first two. After all the coats have been applied allow the coating to dry through but not fully cure and proceed with buffing and polishing the area. If the primer has not been damaged complete all steps except for the ones that involve preparing for primer and primer application. Paint touchup as described in this section are usually the same for every type of product. However, before performing any of the said tasks you should contact the manufacturer and confirm the process. Your end result can be affected by a number of factors, including preparation, coating compatibility, color match, the proper thinner or reducer for the temperature and the experience of the applicator.

Spray Gun Operation

- A. Gun Adjustments:** When dialing in any gun is to refer to the manufacturers specifications for the equipment you are using and identify the recommend air pressure to the gun. Next test the spray pattern by applying the paint to a large piece of masking paper that is taped to a vertical surface. When spray it is important to hold the gun 10 to 12 inches from the surface. Regardless of the brand of gun you should be able to adjust the fluid volume and air flow on the gun itself. The upper control dial adjust the air flow, which also adjusts the spray pattern. The lower dial regulates the amount of fluid the passes the needle and controls the amount of paint that is transferred through the gun. When spraying, always pull the trigger all the way back. Still spraying the masking paper, move the gun across the paper horizontally while making adjustments between the two dials to achieve a spray pattern that is wet from top to bottom. Too reduce the amount of fluid flowing past the needle turn the lower dial to the right and to the left increases the volume on most guns. Turning the top dial to the right not only decreases air flow but also reduces the size of the spray pattern. Turning the dial to the left increases the airflow and the size of the spray pattern. Once you have a good spray pattern set you are ready to apply the paint to the aircraft using the proper techniques that we will discuss in the following section.
- B. Application:** For inexperienced or first time finish applicators, some additional practice maybe needed before applying the finish coat. So after your have prepared, cleaned and primed the aircraft pause for some practice. There are a number of books and videos that can provide you with some basic knowledge with respect to moving the gun across the surface and helpful techniques for achieve a smooth and consistent finish that will be extremely useful. If you are reading this section the aircraft should already be primed and ready for the topcoat finish. There is one main difference between the primer and the topcoat which is that the primer appears flat and the topcoat is glossy. The flat finish of a primer is, one due to the grind of the pigment and two is obtained by trigger control and properly moving the gun across the surface at a consistent speed and distance from the surface. Typically a primer should be applied using a cross coat spray pattern. The most common way to perform the cross coat technique is to spay one pass horizontally and a second pass moving vertically. If you would prefer, spray the first coat vertical and the next horizontal, so long as the first coat is perpendicular to the second. Be sure that the two coats you apply are light. If you apply the primer in light coats you will find that runs and drips are not usually an issue. However, the finish coat requires a bit more experience with a spray gun. Wetter applications of the topcoat help to produce a glossy finished product. Overlapping the spray pattern, proper as well as the consistent movement of the gun, and distance or the gun from the surface also can affect the final finish. It is easy to vary in any of the factors listed above which can lead to runs, drips or dry areas, consistency is a must. Practicing your technique on the masking paper is necessary to gain the skills and confidence to achieve a smooth finish. When practicing first start with a flat horizontal surface. Remember to hole the gun 10 to 12 inches above and perpendicular to the surface. Pull the trigger so that the only air passes through the gun and begin to move the gun across the surface. As you approach the area that you wish to paint pull the trigger all the way back and release the material. You should be moving the gun at approximately 1 foot per second until you reach the end of your reach. When you have reached the end release the trigger enough to stop the flow of material but not enough to stop the air from passing through and then repeat in the opposite direction. Releasing the trigger only enough to stop the flow of material ensures that the pressure at the gun stays consistent and prevents pressure buildup. Another consequence of pressure buildup is paint buildup at the end of each pass, which can lead to runs, drips and sags in the final product. Overlap each pass 50% of the

previous pass. This can be easily accomplished by pointing the middle of the spray at the edge of the previous coat. Continue to overlap with each coat.

Once you have achieved a good finish on a horizontal surface practice on a vertical surface. Applying on vertical surfaces shows you the usefulness of applying a tack coat. A tack coat is a very light coat that provides the foundation for the second coat and helps to prevent runs, drips and sags. Practicing spraying on a horizontal surface overlapping passes and then rotating the air cap 90 degrees to rotate the fan pattern for spraying the vertical surface with the same 50% overlap technique is very important. You should practice the cross coat technique on a vertical surface until you have achieved a smooth, glossy finish with no runs, drips or sags. Once you have perfected your technique you are ready to start the actual project.

- C. Common Gun Issues:** Before you ever begin to spray it is vital the spray pattern be double checked prior to application. This can be performed by just spraying the compatible thinner through the gun. This test indicates the correct spray pattern despite the fact that the thinner or reducer has a lower viscosity than the paint. The test will also verify that your lines are clean if the spray does not appear to have any remnants of previously sprayed paints. If the gun is not working properly you should trouble shoot the problem utilizing the following steps:
- If the material being sprayed is pulsating or spitting it usually means that there is a loose nozzle, clogged vent hole on the supply cup or the packing around the needle may be leaking air.
 - If the spray pattern is on even or off set you may have a clog in the air cap or the ports in the horns.
 - If the spray pattern is heavy on one side rotate the air cap 180°. If the pattern reverses the air cap is the issue. If the problem persists the needle in the gun may be damaged.
 - Other problems with the gun may be the result of improper air pressure, improper reducing of the material or the wrong size spray nozzle.

13. Build a “Poor Man’s” Spray Booth in your Hangar

Ideally, you would have a well lit, clean and temperature controlled room. However since most only have a garage or hangar, we must make the best of our situation and here are some tips as to how we accomplish such a feat. The best way to get as close as possible to ideal, is to construct a “poor man’s” spray booth. First take into account the size of the largest object being sprayed. Commonly people spray their home built aircraft in sections and then assemble the painted parts. Usually the largest section is the fuselage. Build a frame out of wood or PVC large enough to cover the surface being sprayed. Remember to allow yourself enough space to be able to walk around the surface. Also allow enough space for equipment such as lights and the spray rig. Hang the frame from the ceiling use ropes and a pulley system so you can raise and lower the frame. Cover the roof and sides with thick, heavy plastic sheets by stapling or taping the material to the frame. Tape the seams of the plastic sheets together with duct tape. At one end of the booth place an exhaust fan and at the other end a plenum and filter to provide clean air and to prevent outside dust and debris from enter the area. Place a filter in front of the exhaust fan to catch the over spray. Purchase a fan with an explosion proof motor to prevent any chance of sparking. Give yourself plenty of light to work in. Here are some examples of areas in which you do not want to apply paint: out of doors in fog or high humidity or wind, outside or inside when temperatures are over 100°F, in high winds, dusty and dirty areas where air pressure from the spray gun can blow particles into the wet paint or any space that is rented or barrowed

14. Material Storage

All chemical, and especially hazardous material, must be kept in a cabinet intended for flammable material storage that protects them from sources of heat or flames. The products used to paint an aircraft are more often than not flammable in their liquid state. Also, make sure that the area where the chemicals are stored is well ventilated and the ambient temperatures won't fall below freezing or exceed 95°F. Most paints and paint components have a shelf life. Please check the technical data or the label to view the shelf life for a particular product. When using PTI products it is important to note that we do extend the shelf life if we are contacted before the material expires and are able to test the retain to ensure that the material is still usable. If the material is still usable we will extend the shelf life for 6 months. The maximum amount of time to extend the shelf life but you must do so every six months after the first year.

Conclusion

PTI has been in the business of making aircraft paint for more than 70 years. Our capabilities enable us to serve and offer support for the home builder and the private aviation industry. We manufacture products in any quantity and any color giving you the ultimate performance, protection and beauty out of any coating. Thank you for your interest in our products and I hope that I have given you a little more understanding with regard to PTI's products, their purpose and the application of those products. If you are interested in trying some of our products you can contact PTI directly through our website, www.ptipaint.com. Or feel free to pick up our products through aircraft spruce at their Corona, Georgia or Toronto, Canada locations or on-line at www.aircraftspruce.com. If you have additional questions with respect to this manual or any of our products please contact Sean Andrews (sean.andrews@ptipaint.com). Thank you again for your interest in our products and when you think paints and coatings think PTI. You don't want to coat your aircraft with anything less.

This manual was produced by Products Techniques, Inc. Questions about its contents or for additional guidance may directed to PTI by calling 909-877-3951 between the hours of 10:00 AM and 2:30 PM, Pacific Standard Time or writing pti@ptipaint.com. You can also visit us at www.ptipaint.com.