



**GLOBAL
FINISHING
SOLUTIONS**



Ideal Paint Finishing Environments for Performance Coatings

PROTECTING EMPLOYEES & ACHIEVING CODE COMPLIANCE

Whether you are painting a full aircraft or components, the environment in which you apply performance coatings is critical to the health and safety of your employees. The list of aerospace and defense performance coatings is extensive and includes low observable (stealth) coatings, pretreatments and primers with sol-gel, plasma polymer or hexavalent chromates, heat-resistance coatings that are silicone- or ceramic-based, and epoxies.

SAFETY HAZARDS

When spraying performance coatings, flammable, combustible vapors and particles, also known as volatile organic compounds (VOCs), are released into the atmosphere and can collect on unintended

surfaces within the paint booth or finishing environment. This increases the potential for fires or explosions. In an improperly designed booth, a simple ignition source such as static discharge or a non-approved electrical device can ignite these vapors or combustible residue, endangering employees and resulting in damage to the product, equipment and facility.

A properly designed fresh air or recirculation paint booth or finishing system has many safety features, as dictated by code and best available technologies, to protect the safety of employees and the public. To meet fire safety codes, the paint booth's ventilation system must be designed to maintain an allowable level of VOCs. A well-designed finishing system will far exceed these minimum requirements.

Additionally, electrical devices located within and around the paint booth equipment must maintain certain electrical classification requirements to ensure they do not become a source of ignition. Typically, this is an electrical classification

of Class 1 Division I in the paint booth and Class 1 Division II within 3 feet of any booth opening.

To protect your employees and environment in case of a fire, your paint booth and exhaust system must have a fire suppression system. When painting full aircraft, the fire suppression system often includes high-expansion foam systems.

VOLATILE ORGANIC COMPOUND (VOC) & ISOCYANATE EXPOSURE

In addition to safety hazards, exposure (without proper booth ventilation and personal protective equipment) to VOCs can lead to serious health problems, such as damage to the central nervous system, liver and kidneys. Certain paints and primers can also contain other hazardous chemicals and compounds, such as isocyanates. Often used as a component

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of the hardeners in paint, isocyanates are highly reactive, low molecular weight chemicals. Exposure to isocyanates is hazardous to a person's health and can occur by breathing it in or through direct skin contact. With prolonged exposure to isocyanates, a person can develop an allergy, also known as sensitization. Once sensitized, any exposure, even low levels, can result in rashes, hives, asthma attacks or other respiratory issues, which may be life threatening.

Proper protection and a safe, controlled spraying environment with adequate airflow and filtration are vital to the health and safety of your employees. Painters should always wear protective gear, including a full-bodysuit, full-face mask and nitrile gloves, and connect to an appropriate, dedicated breathable air system. Additionally, painting must be done in a controlled environment, such as a paint booth with excellent airflow and filtration. The booth's airflow and exhaust fan must be designed to pull paint overspray and VOCs away from the painter and booth surfaces, and into the exhaust filtration. Proper airflow and filtration has a significant impact on protecting the painter and public from exposure to harmful chemicals.

HEXAVALENT CHROMIUM

Many aircraft pretreatments and primers contain hexavalent chromium, a carcinogenic compound. Health effects of exposure to hexavalent chromium may include lung, nasal and sinus cancer, eye, nose and throat irritation, nasal septum ulcerations, skin irritation, and gastritis or ulcers. In 2006, OSHA issued a final standard for occupational exposure to hexavalent chromium to protect the health

of the painters. Per OSHA, exposure must remain below 25 micrograms of hexavalent chromium per cubic meter of air (25 µg/m³) for aerospace painting. Businesses can stay below these exposure levels by painting in a paint booth with excellent airflow and exhaust ventilation. OSHA also requires employers to provide workers with respirators when best available engineering and work practice controls are unable to reduce worker exposure to hexavalent chromium to at or below the permissible exposure limit.

High-efficiency filters must remove a minimum of 95 percent of particles over 2 microns in size under certain conditions.

To ensure effective reduction of chromate particles, the booth's filtration system must meet national safety standards. Enforced by the EPA, The National Emission Standards for Hazardous Air Pollutants (NESHAP) for Aerospace Manufacturing and Rework Facilities requires aerospace facilities to use a compliant filtration system for their paint finishing operation. High-efficiency filters must remove a minimum of 95 percent of particles over 2 microns in size under certain conditions and be in accordance with EPA Method 319. In some locations, HEPA filtration must also be used to capture at least 99.97 percent of particles at 0.3 microns. In some states, such as California, local codes may also require carbon filters to reduce the emissions of VOCs.

Using a high-efficiency exhaust filtration system, as well as balancing the paint booth pressure, helps to not only minimize employee's exposure to chromates during

the paint application process, but also help reduce exposure to employees and the public outside of the booth.

ENVIRONMENTAL REGULATIONS & CODE COMPLIANCE

Along with OSHA standards, other federal organizations such as EPA, IFC and NFPA have established requirements for the safe application of aerospace and defense performance coatings to protect employees and the environment. Spraying in an open-air environment, such as a building or hanger, or in an aging booth with inadequate airflow and filtration can result in hazardous operating conditions and serious code violation fines. EPA and OSHA continue to crack down on businesses that are in violation of safety standards, such as exposure to high levels of hexavalent chromium and other hazardous chemicals found in performance coatings, and general paint spraying environment regulations.

Local regulations can vary from state to state and county to county. Some states have stricter regulations in place for pollution control and employee safety. It is important to be fully aware of the regulations in your area to ensure your paint finishing operation is code compliant. Reputable paint booth manufacturers, such as Global Finishing Solutions (GFS), will work closely with you to design your finishing equipment to meet or exceed environmental regulations, including all applicable local code requirements.

IDEAL PAINT FINISHING ENVIRONMENT

Aerospace and defense businesses can help ensure the health and safety of their employees and avoid costly environmental

regulation fines by confining all painting operations to a quality paint booth. A properly-designed paint booth system is a key factor in the overall health and safety of your employees.

To ensure optimal airflow, the design and size of your paint booth should consider the size of your product and paint production. Sufficient air velocity, measured in feet per minute (FPM), is necessary to decrease the concentration of flammable material in a paint booth – protecting your employees, product and facility. Your booth manufacturer should work closely with you to define your process requirements to determine the optimal airflow values for your process, while exceeding the minimum safety standard required.

While a quality paint booth system can significantly impact the health and safety of your employees, it is also important that businesses adhere to safe surface preparation and painting practices, such as the use of personal protective equipment and proper booth maintenance and operation, to better protect against the health hazards of performance coatings.

IMPROVING PAINT FINISH QUALITY & REDUCING COST

In addition to health and safety reasons, the environment in which performance coatings are applied is crucial to the success of the final finish. Many performance coatings require specific humidity and temperature levels to achieve the proper bond of the coating to the material. Some performance coatings, such as low observable coatings, must be applied to extremely precise thickness tolerances over multiple layers. If the coatings are not applied properly, the result can mean costly rework or even worse, the failure of the coating.

A well-designed and engineered paint booth can significantly improve the quality of a paint finish. Airflow, contamination control, temperature and humidity controls, and lighting are key booth components that contribute to a high-quality paint finish that reduces the need for rework.

UNIFORM AIRFLOW

A paint booth's airflow has a significant impact on the quality of the paint finish, as well as protecting your employees from exposure to hazardous vapors. Your paint booth manufacturer should work closely with you to develop an airflow design tailored to your specific process to provide optimal application conditions and maintain a high level of safety for your employees and facility.

Regardless of the booth's airflow design, uniformity of air velocity is critical to the success of performance coating applications. Air velocity should be consistent throughout the booth to reduce contamination and achieve consistent curing on all sides of the aircraft or component. Another way to help eliminate contamination of the coating surface is to ensure the booth's air pressure is correctly balanced. Proper pressure control keeps

dirt, dust and other contaminants out of the paint job, reducing costly rework.

Unless your process specifically dictates otherwise, a good booth design will incorporate a slightly negative pressure to prevent the escape of process fumes and potentially harmful VOCs to the work space surrounding the booth. During commissioning of a new paint booth, a technician will precisely calibrate the booth to provide enough pressure to effectively capture and contain the process air, while minimizing contamination entering from the area surrounding the booth. A quality booth system will also provide superior sealing of all construction features, including the doors, to eliminate contamination.

CLEAN, FILTERED AIR

The air in the paint booth is only as good as the air that comes in it. To ensure clean, contaminant-free airflow in your paint booth, it is important that your booth has an effective, high-quality intake filtration system. A properly engineered, pressurized paint booth will use multiple stages of intake filtration, ending with a final stage at the booth's plenum. This provides the highest level of filtration,



while evenly distributing the air across the booth. High-efficiency filters trap dirt and dust before they enter the booth, allowing for quality paint finishes.

TEMPERATURE & HUMIDITY CONTROL

Aerospace and defense performance coatings, especially stealth coatings, can be very demanding of the application conditions. These coatings require a narrow temperature range and specific humidity level to adhere properly. A paint booth can be integrated with specialized equipment and controls accommodate these strict environmental needs and create the ideal finishing environment for performance coatings.

These systems often use mechanical cooling and dehumidification, as well as a method of humidification, such as direct injection steam or evaporative humidifiers, which are carefully designed and incorporated into your finishing environment. All mechanical equipment designs are tailored to provide the required operating conditions based on the outside ambient environmental conditions of your facility.

LIGHTING

A well-lit paint booth allows the painters to accurately see how much paint they are applying and where they are applying it

to ensure even paint coverage on all sides of the aircraft or component. Whether you are painting full aircraft, subassemblies or components of an aircraft, the paint booth lighting should be engineered to achieve optimal intensity and color rendering in the areas where paintable surfaces are located.

Careful consideration should be given to the lighting layout to avoid unwanted shadowing on the part and allow light to be cast onto the floor in strategic locations to allow for reflectivity to the underside of the aircraft or component. Complete visibility of all sides of the aircraft or component helps to eliminate paint imperfections and dust and dirt inclusions, as well as brings light to corroded areas in need of repair.

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QUALITY PAINT FINISH ON THE FIRST PASS

Whether painting complete aircraft or a range of subassemblies and components, a first-pass quality finish is important to reduce high production costs and time

spent on rework, which results in delays to the production schedule. A well-engineered paint booth that is specifically designed for the product you are finishing will allow you to achieve better quality paint jobs the first time, helping to ensure the success of performance coatings.

MORE THAN PAINT – DESIGNING AN END-TO-END FINISHING SOLUTION

To completely maximize productivity, reduce costs and keep employees safe, aerospace and defense OEMs should look at all their prep, paint and cure processes and environments. An end-to-end finishing solution can have a significant impact on the quality of your paint job and production rate.

SURFACE PREPARATION

Preparing the surface of an aircraft, missile, subassembly or component for paint is a critical part of the painting process to ensure proper adhesion of performance coatings. Containing processes such as sanding, grinding and masking in a safe, controlled environment helps to increase production and improve the overall paint job. Businesses can increase production rates by using a prep booth for surface preparation tasks, allowing products to be prepped while others are being painted. Removing prep processes from the paint environment also helps to keep contamination out of the paint job for a better quality final finish with reduced rework.

Additionally, businesses can save in capital equipment and operating costs with a prep booth. Since the environmental conditions required for many surface preparation processes are considerably less stringent than paint processes, it allows for design considerations that reduce cost and increase energy efficiency. To further increase





production capacity, manufacturers may also look at isolating priming to a separate booth. Then, the finishing paint booth can be reserved for applying top coat, enabling businesses to move more product through their facility faster. A well-lit, well-ventilated booth allows for a precise application and drying of primers and top coatings.

Your processes should be designed to maximize floor space, optimize efficiency and increase production.

INTRODUCING ROBOTICS INTO YOUR PAINT PROCESS

Another way aircraft and defense manufacturers can improve their finishing process is with robotic application equipment. High-performance, low observable (LO) coatings, for example, are very expensive and require multiple applications in precise thicknesses and distribution. Robots can be programmed to apply a very specific amount of LO coating to the product, increasing efficiency and

reducing waste in the paint process. Robots are also beneficial when painting aircraft components with highly contoured surfaces, which can be extremely challenging to paint manually.

Using robotic application equipment not only can optimize your paint usage, which reduces costs, but it can also improve the quality of the paint finish, reduce rework due to human error and increase your production rate. Global Finishing Solutions has experience integrating robotics into performance coating applications and can work with you to determine the best solution for your business' needs.



PAINT MIXING & STORAGE

Paint, primer and other chemicals used in your business' processes must be stored in an area designed to meet all industry standards for the safe storage of hazardous materials. Hazardous material storage buildings minimize the risk of explosion and contain potential spills to keep your employees, building and investments safe.

In addition to storage, paint should also be mixed in a safe, controlled environment to prevent contamination in the paint and provide ventilation of hazardous vapors to protect the painter's health. Paint mixing can be done in a hazardous material storage building or in a separate paint mix room. Mix rooms are ideal as they can be attached to a paint booth for easy transfer of paint into the booth and reduce the risk of bringing contaminants into the booth.

OPTIMIZING YOUR PRODUCTION LAYOUT

How your product moves through your facility during the painting process is essential to maximizing productivity and throughput. Businesses should design their processes to maximize floor space, optimize efficiency and increase production. Global Finishing Solutions can work with you to design a solution that best fits within your production needs, floor space and budget requirements.

We can also help you decide the right finishing environments for each step of your paint process and determine if robotics can benefit your production. Contact Global Finishing Solutions today to learn how an end-to-end finishing solution can positively impact your business.

