Industrial Spray Booth Daily Maintenance and Service Technical White Paper

1 Foreword

In the industrial coating production process, spray booths are core facilities for achieving precise spraying, controlling coating environment, and ensuring operation safety. Their main function is to create a clean, constant temperature and humidity, dust-free spraying space through directional airflow organization, while collecting and treating paint mist, dust, and other pollutants generated during the spraying process to prevent their diffusion to the working environment. The operating status of spray booths directly determines key quality indicators of sprayed workpieces such as coating smoothness, adhesion, and color uniformity. Equipment failures not only cause production interruptions, increase maintenance costs, but may also cause fire, poisoning, and other safety accidents due to paint mist leakage and static electricity accumulation, and even shorten

Currently, with the continuous upgrading of industrial coating technology, the automation level and structural complexity of spray booths are gradually increasing, putting forward higher requirements for the professionalism and standardization of equipment maintenance and service. However, some enterprises have problems such as non-standard maintenance processes, unclear cycles, and unprofessional operations, leading to frequent spray booth failures, unstable coating quality, and shortened equipment service life. To solve these problems, standardize spray booth maintenance operations, and improve equipment management levels, this technical white paper is compiled based on industry practical experience and relevant national standards to clarify the technical key points, operational specifications, and safety requirements for daily spray booth maintenance and service.

This white paper is compiled following the principles of "scientific standardization, practical feasibility, and safety and efficiency." It covers the maintenance and service of spray booth core systems (cleaning system, filtration system, operating equipment, electrical system, temperature and humidity control system), clarifying the technical requirements and operational processes for daily cleaning, regular inspection, component replacement, professional calibration, and

other aspects. It is applicable to daily management and maintenance operations of various industrial spray booths and can be used by equipment operators, maintenance technicians, and equipment management personnel. It can also serve as a reference for enterprises to formulate equipment maintenance management systems.

2 Scope and Referenced Standards

2.1 Applicable Scope

This white paper is applicable to various industrial spray booths, including manual spray booths, semi-automatic spray booths, and fully automatic spray booths (including electrostatic spray booths, high-pressure airless spray booths, etc.). It covers the daily maintenance and regular maintenance operations of all related components involved in coating operations, including spray booth main structure, filtration system, fan motors, transmission components, electrical systems, constant temperature and humidity equipment, etc. The maintenance requirements specified in this white paper can serve as core content of enterprise equipment maintenance procedures and can also be used as a basis for skill training and assessment of related personnel.

2.2 Referenced Standards

During the compilation of this white paper, the following national and industry standards are mainly referenced. Relevant operations must strictly follow the standards

requirements:

GB 12367-2006 "Safety Regulations for Coating Operations -

Safety Code for Electrostatic Spray Painting Process"

GB/T 2893.1-2013 "Graphical Symbols - Safety Colours - Part 1:

Safety Colours" GB 6514-2008 "Safety Regulations for Coating

Operations - Safety Code for Paint Spraying Process and

Ventilation Purification" GB/T 14441-2017 "Safety Regulations

for Coating Operations - Terminology"

JB/T 10242-2016 "Spray Rooms"

3 Core System Structure and Maintenance Principles of Spray Booths

3.1 Core System Structure

Industrial spray booths mainly consist of the following core systems, which cooperate with each other to ensure normal operation of spray booths: Main structure: Including booth body, doors and windows, floor, workbenches, etc., providing enclosed space for spraying operations and preventing paint mist diffusion;

Filtration system: Including primary filters, medium-efficiency filters, HEPA filters, dust collection devices, etc., responsible for filtering dust and impurities in the air entering and exiting the booth;

Operating equipment system: Including fans, motors, drive belts, chains, spray guns, pipelines, etc., responsible for airflow organization, workpiece transmission, and spray painting operations;

Electrical system: Including lighting, control systems, terminals, switches, explosion-proof equipment, etc., providing power support for equipment operation and ensuring operation safety;

Temperature and humidity control system: Including constant temperature and humidity equipment, thermohygrometers, etc., responsible for regulating indoor temperature and humidity to ensure coating quality.

3.2 Maintenance Principles

Spray booth maintenance must follow the following core principles to ensure scientific, safe, and effective operations:

Prevention-oriented: Adhere to "daily maintenance normalization and regular maintenance institutionalization," proactively investigating potential faults, avoiding equipment "operation with faults," and reducing failure rates;

Standardized operation: Strictly follow the requirements of this white paper and equipment manuals to standardize operation processes, avoiding equipment damage or safety accidents caused by improper operations;Classified maintenance: Develop differentiated maintenance cycles and requirements based on the structural characteristics and operating loads of each spray booth system, focusing on key components (such as filters, fans, explosion-proof electrical equipment);

Safety first: Safety protection measures must be implemented before maintenance operations, turning off power and air sources, wearing protective equipment, and eliminating safety hazards;

Full traceability: Maintain detailed maintenance records, recording maintenance time, maintenance items, replaced components, calibration parameters, and other information for subsequent traceability and equipment status analysis.

4 Daily Maintenance and Service Technical Specifications

4.1 Daily Cleaning (After Daily Operations/Weekly Regular)

During spray booth usage, pollutants such as paint drips, paint mist, and dust are generated. If not cleaned promptly, they accumulate on equipment surfaces and inside pipelines, affecting equipment operating efficiency and coating quality, and even accelerating equipment wear. Daily cleaning should be divided into immediate cleaning and regular cleaning, clarifying cleaning scope, methods, and precautions.

4.1.1 Immediate Cleaning (After Each Operation)

After each spraying operation, immediate cleaning must be carried out to avoid difficulty in removing dried pollutants. The specific operational requirements are as follows:

Spray gun and cup cleaning: Immediately clean residual paint in spray guns and cups. Select appropriate thinners based on paint types (e.g., banana oil for oil-based paint, and special water-based thinners for water-based paint). Wipe spray gun nozzles, needles, and cup interiors repeatedly to ensure no paint residue, preventing nozzle clogging and needle wear that affect next spraying results;

Work surface cleaning: Clean paint drips and paint mist residue on workbenches and floors. Use wet cloths with neutral cleaners for wiping. For dried paint deposits, use thinners to soak first before cleaning to ensure work surfaces are free of debris and paint residue;

Partial cleaning: Clean paint mist and dust at spray booth entrances and door and window edges to avoid pollutant diffusion outside the booth, and prevent door and window opening and closing jamming.

4.1.2 Regular Cleaning (Weekly)

Weekly comprehensive cleaning of spray booths is required, focusing on areas not easily cleaned immediately to ensure overall equipment cleanliness. The specific operational requirements are as follows:

Interior wall cleaning: Thoroughly clean spray booth interior walls (walls, ceilings). First use industrial vacuum cleaners to remove surface dust, then wipe with wet cloths and neutral cleaners to avoid dust accumulation forming particles that affect the flatness of subsequent spray coatings. For stubborn paint mist on interior coatings, use special paint removers and wipe gently to avoid damaging interior coatings from excessive force;

Door and window cleaning: Wipe door and window glass and frames, ensuring glass transparency for easy observation of operations,and clean paint mist and dust on frames to ensure smooth door and window operation;Exhaust channel cleaning: Check exhaust outlets and dust collection devices, clean accumulated dust and paint sludge inside to prevent exhaust system blockage, ensure smooth exhaust, and avoid paint mist backflow contaminating the spraying environment. For dust collection bags and boxes, remove, clean thoroughly, and replace immediately if damaged.

4.1.3 Cleaning Precautions

Corrosive cleaners (such as strong acids and alkalis) are strictly prohibited during cleaning to prevent damage to interior booth coatings, equipment surfaces, and seals;

During cleaning, avoid washing electrical equipment, fans, motors, and other components with water directly to prevent short circuits and equipment damage;

After cleaning, ensure no water accumulation or residual cleaners inside to avoid reactions between cleaners and paint affecting paint adhesion;

Waste rags, waste thinners, paint residue, etc., generated from cleaning must be collected and stored according to hazardous waste management regulations and cannot be discarded arbitrarily.

4.2 Filtration System Maintenance (Regular Inspection + Replacement as Needed)

Air filtration systems are the key core for ensuring coating quality. Their main function is to filter dust and impurities in the air entering the spray booth, ensuring a clean spraying environment, while filtering exhaust paint mist and dust to prevent

pollutant emissions from exceeding standards and damaging exhaust equipment. Filtration system maintenance must strictly follow the principle of "regular inspection and replacement as needed," clarifying inspection cycles, replacement standards, and operational specifications.

4.2.1 Regular Filter Inspection

Based on filter types (primary, medium-efficiency, HEPA), differentiated inspection cycles are developed, focusing on inspecting filter operating status. The specific requirements are as follows:

Primary filters: Inspect once weekly. Focus on surface dust accumulation. If excessive dust, blockage, damage, or deformation is found, immediately clean with compressed air (wear protective masks during blowing to avoid dust inhalation). Replace promptly if cleaning cannot meet filtration requirements;

Medium-efficiency filters: Inspect once weekly. Check for dust accumulation, damage, or leakage on filter surfaces. Clean or replace immediately if severe dust accumulation or decreased filtration efficiency is found (can be determined through air volume testing);

HEPA filters: Inspect once monthly. Focus on checking for leakage, damage, or deformation. Also test supply air volume. If air volume significantly decreases (below 80% of equipment rated air volume), or damage or leakage appears on filter surfaces, replace promptly;Dust collection devices: Inspect once weekly. Check dust accumulation in dust collection bags and boxes and clean promptly. Replace dust collection bags immediately if damaged or aged to ensure dust collection effectiveness.

4.2.2 Filter Replacement Cycles

Filter replacement cycles should be reasonably adjusted based on working conditions (spraying frequency, ambient dust concentration, paint type). Replacement cycles under conventional working conditions are as follows. Special working conditions require appropriate shortening:

Primary filters: Replace every 1-2 months;

Medium-efficiency filters: Replace every 3-4 months;

HEPA filters: Replace every 6 months;

Special working condition adjustments: If spraying operations are frequent (daily operation exceeds 8 hours) or ambient dust is high (such as nearby grinding or cutting operations), replacement cycles can be shortened. Inspection every 2-3 months is recommended, and replacement times should be adjusted based on actual situations. For water-based paint spraying, as paint mist humidity is relatively high, medium-efficiency and HEPA filter replacement cycles can be appropriately shortened.

4.2.3 Filter Replacement Specifications

During filter replacement, the following operational specifications must be strictly followed to avoid affecting filtration effectiveness or causing safety hazards due to improper operations:

Before replacement, all spray booth power and air sources must be turned off. Confirm equipment has completely stopped before replacement operations;

Operating personnel must wear protective gloves, masks, goggles, and other protective equipment to avoid dust inhalation and skin contact with pollutants;

When removing old filters, handle gently to avoid filter damage causing dust to scatter inside the spray booth;

When installing new filters, ensure filters fit tightly against installation slots without gaps to prevent unfiltered air from entering the spraying area, affecting coating quality. Installation direction must comply with equipment requirements and cannot be reversed;

Replaced waste filters must be properly collected and disposed according to hazardous waste management regulations and cannot be discarded arbitrarily to avoid environmental pollution;

After replacement, start equipment for trial operation, test supply air volume and filtration effectiveness, and only put into normal use after confirming no abnormalities.

4.3 Equipment Inspection and Lubrication (Monthly Regular)

Spray booth operating equipment (fans, motors, transmission components, spray guns, pipelines, etc.) are the core for ensuring normal operation. Regular inspection and lubrication can effectively reduce equipment wear, investigate fault potential, extend equipment service life, and ensure stable, fault-free operation

processes. Monthly comprehensive inspection and lubrication maintenance is required for various operating equipment. The specific requirements are as follows:

4.3.1 Fan and Motor Maintenance

Operating status inspection: Start fans and listen for abnormal noise or vibration during operation. If excessive noise or obvious vibration occurs, stop for inspection. Check if fan blades have dust accumulation, deformation, or wear, or if bearings are damaged. Clean blade dust and replace damaged components promptly;

Motor inspection: Check motor operating temperature (normal operating temperature not exceeding 75°C) and whether current meets equipment rated standards. Check if terminals are secure to avoid poor contact and short circuit failures caused by loosening. Check motor housings for damage or corrosion. Repair or replace promptly if found;

Lubrication maintenance: Check motor bearings every 3 months and add specialized lubricating oil (select appropriate specifications based on motor model). Add appropriate amounts, avoiding too much or too little affecting bearing operation. Synchronously perform lubrication maintenance on fan bearings to ensure smooth operation.

4.3.2 Transmission Component Maintenance

Tension inspection: Check tension of drive belts and chains. Adjust tensioning devices promptly if loosening occurs to ensure smooth transmission. If drive belts show cracks or severe wear, or chains show rust or jamming, replace immediately;

Lubrication maintenance: Add lubricating oil (or grease) to bearings, chains, and other moving parts monthly to reduce friction and wear and avoid jamming. After adding, start equipment for trial operation to ensure transmission components operate smoothly without abnormal noise.

4.3.3 Spray Gun and Pipeline Maintenance

Spray gun inspection: Check spray gun nozzles and needles for wear or clogging. Severe nozzle wear causes uneven spraying and paint mist diffusion.

Needle clogging affects paint output volume. Repair or replace promptly. Check spray gun seals for aging or leakage and replace seals if leakage is found;

Pipeline inspection: Check paint pipelines and air pipelines for leakage, aging, or damage. Repair or replace pipelines promptly if leakage is found. Regularly flush pipelines with appropriate thinners to avoid paint residue clogging pipelines. After flushing, use compressed air to dry pipelines to prevent thinners mixing with paint affecting coating quality.

4.4 Electrical System Inspection (Monthly Regular)

Paint, thinners, etc., used inside spray booths are all flammable and explosive materials. Safe operation of electrical systems is extremely important. Electrical system maintenance should focus on investigating safety hazards such as circuit aging, short circuits, and static electricity accumulation, and strictly follow explosion-proof, grounding, and other safety requirements. The specific operational specifications are as follows:

4.4.1 Routine Electrical Inspection

Circuit inspection: Check circuit wiring of indoor lighting, control systems, and exhaust equipment. Check for exposed, aged, or damaged wires. Check if terminals are loose. Repair or replace promptly if found. Check if wire installation is standardized to avoid wire crushing or wear;

Switch and button inspection: Check if various switches and buttons are sensitive and effective, avoiding jamming or failure. Replace switches immediately if malfunction occurs to prevent inability to control equipment operation;

Instrument inspection: Check if displays of various instruments in the electrical control system (such as ammeters and voltmeters) are normal. Calibrate or replace instruments promptly if deviations occur.

4.4.2 Explosion-Proof Inspection

Equipment explosion-proof requirements: Ensure all electrical equipment inside spray booths (lighting, motors, switches, instruments, etc.) comply with explosion-proof standards (Ex d IIB T3 and above). Non-explosion-proof electrical equipment is strictly prohibited to prevent electrical sparks from causing flammable and explosive gas combustion or explosion;

Sealing inspection: Check sealing of explosion-proof lights and explosion-proof switches to prevent paint mist and dust from entering equipment interiors and causing sparks. Replace seals promptly if aging or damaged;

Explosion-proof zone management: Strictly prohibit storing flammable and explosive materials (except required paint and thinners for operations) near electrical equipment to ensure no debris around electrical equipment for easy inspection and maintenance.

4.4.3 Grounding Inspection

Grounding device inspection: Check if grounding devices of spray booth main body and equipment (fans, motors, spray guns, etc.) are secure and if grounding wires are intact without breakage or aging;

Grounding resistance testing: Test grounding resistance monthly to ensure grounding resistance meets standard requirements (≤4Ω) and prevent safety accidents caused by static electricity accumulation. If grounding resistance exceeds standard, investigate grounding devices promptly and add grounding electrodes to ensure effective grounding;

Static protection: Before spraying operations, confirm static grounding is normal. Operating personnel must wear anti-static gloves and clothing to avoid static electricity accumulation causing sparks.

4.5 Environmental Temperature and Humidity Control (Daily Pre-Operation Inspection)

Suitable temperature and humidity are important conditions for ensuring coating quality. Excessive or insufficient temperature and humidity cause coating defects such as sags, pinholes, wrinkles, slow drying, and reduced adhesion, affecting workpiece coating quality. Daily inspection and adjustment of spray booth temperature and humidity is required to ensure compliance with spraying operation standards.

4.5.1 Temperature and Humidity Standard Ranges

According to GB 6514-2008 "Safety Regulations for Coating Operations - Safety Code for Paint Spraying Process and Ventilation Purification", the temperature and humidity inside spray booths during industrial spraying operations should be controlled within the following standard ranges:

Temperature: 20-25°C;

Relative humidity: 50-70%.

If ambient temperature and humidity exceed the above standards, turn on constant temperature and humidity equipment for adjustment. Spraying operations can only begin after temperature and humidity reach standards. For special paints (such as low-temperature cure paints and high-temperature cure paints), adjust temperature and humidity ranges according to paint manual requirements.

4.5.2 Daily Inspection and Adjustment

Before daily operations, check if thermohygrometer displays are normal. Calibrate or replace thermohygrometers promptly if deviations occur;

During rainy seasons, summer high temperatures, and winter low temperatures, increase temperature and humidity inspection frequency (every 2 hours), and adjust constant temperature and humidity equipment operating status promptly. During summer high temperatures, turn on cooling equipment to lower temperature. During winter low temperatures, turn on heating equipment to raise temperature. During rainy seasons with high humidity, turn on dehumidification equipment to lower humidity;

After temperature and humidity adjustment, keep equipment operating stably and avoid excessive temperature and humidity fluctuations that affect coating quality. Monitor temperature and humidity in real-time during operations and stop to adjust immediately if abnormalities occur.

4.5.3 Precautions

Avoid spraying in high-temperature and high-humidity environments (temperature >30°C, relative humidity >75%) to prevent coating problems such as moisture return, fogging, and reduced adhesion;

Avoid spraying in low-temperature environments (temperature <15°C) to prevent slow paint drying and defects such as sags and pinholes, affecting construction efficiency and coating quality;

Constant temperature and humidity equipment requires regular inspection and maintenance (monthly inspection). Clean internal dust accumulation, check cooling, heating, and dehumidification system operating status to ensure normal equipment operation.

4.6 Regular Professional Maintenance (Semi-Annual)

In addition to daily maintenance, to ensure spray booths remain in optimal operating condition and proactively investigate potential faults, it is recommended to have professional technicians conduct comprehensive inspection and calibration of spray booths every six months and carry out professional maintenance operations.The specific requirements are as follows.

4.6.1 Comprehensive Overhaul

Core equipment overhaul: Comprehensive inspection of core components such as fans, motors, filtration systems, electrical systems, and constant temperature and humidity equipment. Repair or replace aged, worn, or damaged components (such as bearings, seals, filters, wires, etc.);

Main structure overhaul: Check spray booth sealing and repair air leakage areas (such as aged door and window sealing strips and booth body gaps) to ensure stable indoor airflow and avoid unfiltered air entering. Check interior booth coatings and repair peeling or damage promptly to prevent paint mist penetration;

Pipeline overhaul: Comprehensive inspection of paint pipelines and air pipelines. Clean residual paint and impurities inside pipelines. Repair or replace aged or damaged pipelines to ensure no leakage;

Safety equipment overhaul: Check effectiveness of firefighting equipment (fire extinguishers, hydrants, etc.). Replace expired or ineffective firefighting equipment. Check if emergency lighting and emergency stop buttons work normally to ensure normal use in emergency situations.

4.6.2 Performance Calibration

Air pressure testing: Conduct air pressure testing to check spray booth supply air pressure and exhaust pressure to ensure compliance with equipment rated standards and avoid airflow turbulence affecting spraying results. If air pressure is abnormal, adjust fan operating parameters or clean exhaust channels;

Temperature and humidity calibration: Calibrate temperature and humidity control systems and thermohygrometers to ensure accurate temperature and humidity displays and effective regulation, meeting spraying operation standards;

Electrical calibration: Calibrate various instruments in electrical control systems (ammeters, voltmeters, temperature controllers, etc.) to ensure accurate parameter displays and normal control logic;

Filtration efficiency testing: Test filter filtration efficiency to ensure compliance with relevant standards. Replace filters promptly if filtration efficiency does not meet standards.

4.6.3 Maintenance Records

After professional maintenance is completed, detailed maintenance records must be kept. Record contents include: maintenance date, maintenance personnel, maintenance items, names and specifications of replaced components, calibration parameters, equipment operating status, etc. This facilitates subsequent traceability and maintenance reference. Simultaneously, incorporate maintenance records into equipment archives and regularly analyze equipment operating status to optimize maintenance

5 Safety Precautions

Spray booth maintenance operations involve flammable and explosive materials, electrical equipment, and overhead work, presenting certain safety hazards. The following safety precautions must be strictly followed to eliminate safety accidents:

Before maintenance operations, all spray booth power, air sources must be turned off and paint supply cut off. Confirm equipment has completely stopped before cleaning and maintenance operations. Set "Do Not Energize, Under Maintenance" warning signs beside equipment before operations to prevent misoperation;

During maintenance, operating personnel must wear protective equipment (gloves, masks, goggles, anti-static clothing, etc.) to avoid contact with harmful substances such as paint, thinners, and dust, and prevent skin corrosion and inhalation poisoning;

Smoking and use of open flames (such as lighters and matches) inside spray booths is strictly prohibited. Storage of flammable and explosive materials (except required paint and thinners for operations) is strictly prohibited. Adequate firefighting equipment (dry powder fire extinguishers, carbon dioxide fire

extinguishers, etc.) must be provided inside spray booths and regularly checked for effectiveness to ensure normal use in emergencies;

During maintenance operations, avoid using tools that generate sparks (such as metal wrenches striking and non-explosion-proof power tools) to prevent causing fires and explosions;

During overhead work (such as cleaning booth ceilings and inspecting fans), erect safety scaffolds or use climbing ladders. Operating personnel must wear safety harnesses to prevent falls from height;

After maintenance completion, comprehensively check equipment status. Only start equipment for operations after confirming no omissions or safety hazards (such as no pipeline leakage, secure electrical wiring, normal grounding, etc.);

If major equipment faults are found (such as fan faults, circuit short circuits, severe filtration system blockage, paint leakage, etc.), immediately stop operations, turn off power and air sources, evacuate site personnel, and contact professional personnel for repair. Do not arbitrarily disassemble or repair to avoid enlarging faults or causing safety accidents;

After maintenance operations, promptly clean the site. Collect and dispose of waste rags, waste thinners, and waste components according to hazardous waste regulations and keep the work site clean.

6 Maintenance Records and File Management

To achieve full traceability of spray booth maintenance and optimize equipment management levels, a comprehensive maintenance records and file management system must be established. The specific requirements are as follows:

Establish equipment files: Establish independent equipment files for each spray booth, recording equipment models, specifications, installation dates, manufacturers, repair records, maintenance records, and other information to achieve full lifecycle equipment management;

Standardized record filling: After each maintenance operation, maintenance records must be filled promptly and in detail, recording maintenance dates, maintenance personnel, maintenance items, replaced components, calibration parameters, equipment operating status, and other information. Records must be truthful, accurate, and complete, archived after signed confirmation;

File storage: Maintenance records and equipment files must be uniformly stored in dry, ventilated, and light-proof locations to avoid file damage or loss. File storage period should be no less than equipment service life for subsequent traceability and equipment status analysis;

Regular analysis: Quarterly summary analysis of maintenance records to investigate common equipment faults and vulnerable components, optimize maintenance cycles and plans, improve equipment operating stability, and reduce failure rates.

7 Conclusion

Daily maintenance and service of industrial spray booths are key links for ensuring coating operation quality, improving production efficiency, avoiding safety hazards, and extending equipment service life. This white paper, based on national relevant standards and industry practical experience, systematically expounds the maintenance technical specifications, operational processes, cycle standards, and safety precautions for spray booth core systems, providing enterprises with scientific, standardized, and actionable technical guidance.

Enterprises should, based on their own spray booth models and working conditions, formulate comprehensive equipment maintenance management systems according to the requirements of this white paper, clarify job responsibilities, strengthen skill training for relevant personnel, and ensure standardized and regulated maintenance operations. Simultaneously, regularly summarize maintenance experience, optimize maintenance plans, and promptly investigate equipment potential faults to ensure spray booths always remain in optimal operating condition, providing guarantees for safe, efficient, and high-quality industrial coating operations.

This white paper will be revised and improved as industrial coating technology develops and spray booth equipment upgrades, providing more targeted and practical technical guidance for the industry.