

## CHAPTER 21 – PAINT AND SPRAY FINISH OPERATIONS

A. INTRODUCTION.....	1
B. CHAPTER SPECIFIC ROLES AND RESPONSIBILITIES.....	1
C. HAZARD IDENTIFICATION.....	2
D. HAZARD CONTROLS.....	3
E. INSPECTIONS AND MAINTENANCE.....	11
F. PERSONAL PROTECTIVE EQUIPMENT (PPE) AND PERSONAL HYGIENE .....	12
G. TRAINING .....	12
H. RECORDS AND REPORTS.....	13
I. REFERENCES .....	13

# CHAPTER 21 – PAINT AND SPRAY FINISH OPERATIONS

## A. Introduction

1. The purpose of this Chapter is to establish fire, safety and employee health requirements for all indoor spray finish to include: water-based, flammable or combustible paints, varnishes, lacquers, glues, or similar substances. Spray operations involving these materials typically occur in a dedicated area, (e.g., paint spray booths, paint spray rooms). Spray booths or rooms shall be designed for these activities to safely occur on an intermittent or continuous basis.

It is not required that a paint booth room be used when just using a can of spray paint, however, the area must be well ventilated.

2. All Smithsonian Institution (SI) paint spray operations shall conform with the requirements of the following regulations:
  - a. Occupational Safety and Health Administration (OSHA) [29 Code of Federal Regulations \(CFR\) 1910.94, "Ventilation,"](#) Part C, "Spray Finishing Operations;"
  - b. [OSHA 29 CFR 1910.107,](#) "Spray Finishing Using Flammable and Combustible Materials;"
  - c. National Fire Protection Association (NFPA) Standard 30, "Flammable and Combustible Liquids Code;"
  - d. NFPA Standard 33, "Spray Application Using Flammable or Combustible Materials;"
  - e. NFPA Standard 70, National Electric Code (NEC).
  - f. NFPA Standard 91, "Standard for Exhaust Systems for Air Conveying of Vapors, Gases, Mists, and Noncombustible Particulate Solids;"
  - g. International Code Council, International Fire Code, Flammable Finishes.

## B. CHAPTER SPECIFIC Roles and Responsibilities

1. Directors shall ensure that proper spray paint emissions permitting is obtained for all spray paint operations as required by Federal, State, and Local regulations.
2. Safety Coordinators shall
  - a. Review and inspect spray painting operations during their annual physical self inspection.

- b. Coordinate any ventilation evaluations and exposure sampling with the Office of Safety, health and Environmental Management (OSHEM), as needed.
3. Supervisors shall:
- a. Ensure that required inspections and maintenance are performed as required.
  - b. Develop Job Hazard Analyses (JHA) for employees performing paint spray operations per [Chapter 4, "Safety Risk Management Program"](#), of this *Manual*.
  - c. Provide training to employees under their purview that use paint spray operations in all sections of this Chapter relative to their work tasks and workplace safety hazards prior to performing work.
  - d. Provide appropriate personal protective equipment (PPE) to employees working with spray paint operations and ensure they use it. PPE should also be included on the JHA.
4. Employees shall:
- a. Attend required training on spray paint operations and apply these lessons and safe work practices to their assigned job task.
  - b. Ensure paint spray equipment remains in serviceable condition or removes equipment from service.
  - c. Wear appropriate PPE.
5. Office of Safety, Health, and Environmental Management (OSHEM) shall:
- a. Provide technical assistance on emission permitting and spray paint operations as required.
  - b. Provide evaluation of the effectiveness of spray paint booth ventilation systems.

### **C. Hazard Identification**

1. Paint spray operations may present both health and physical hazards from the chemicals contained within the paint or applied material.
2. Potential health hazards include exposure to solid and liquid aerosols as well as to organic solvents and their vapors through inhalation or dermal absorption. Skin contact may also cause dermatitis and localized skin irritation. Inhalation and absorption of organic solvent and vapors often results in central nervous system (CNS) disorders. Some paint pigments and additives are highly toxic, such as lead, cadmium and chromium.

3. Physical hazards include:
  - a. Exposure to flammable/combustible or explosive paint spray mists, particulates and vapors, as well as accumulated paint spray residues.
  - b. Pressure equipment used in painting operations may be hazardous because of its compressed air component.
4. Personnel engaged in paint spray operations shall review applicable Material Safety Data Sheets (MSDS's) prior to work, in order to understand the properties and hazards of the solvents in use and their safety precautions.

## **D. HAZARD CONTROLS**

- a. Location of Paint Spray Operations
  - (1) Spray booths. When possible, paint spray booths shall be located in the paint shop. All spray booths shall be installed to conform to the requirements of NFPA 33.
  - (2) Paint spray operations not conforming to (1) must be approved by OSHEM and meet the following minimum requirements:
    - (a) The room is specifically designed for that purpose;
    - (b) The room is protected with an automatic sprinkler system; and
    - (c) The room is separated vertically and horizontally from administrative or public assembly occupancies by at least two-hour fire resistant construction.
  - (3) Size of booth or area. The size of the spray booth or designated spray area must be large (deep) enough to contain the largest object being coated. Sufficient space must be provided to permit airflow on all sides of the object.
- b. Fire Protection/Prevention
  - (1) Prevention. Paint spray operations of concern are those operations having a fire potential, e.g., paint removal, solvent wipe, and paint application using spray apparatus. Certain paints, lacquers, varnishes, shellacs, solvents, and thinners are very flammable. Other materials, under certain conditions, will burn violently.
  - (2) The use of solvents for cleaning operations shall be restricted to those having flashpoints above 100°F. However, per 29 CFR 1910.107 when cleaning spray nozzles and auxiliary equipment, you may also use solvents having flashpoints not less than those normally used in spray operations. All cleaning shall be conducted inside spray booths with the ventilating equipment operating.

- (3) Portable fire extinguishers shall be provided at each paint spray operation area in accordance with NFPA 10. The fire extinguishers shall be suitable to handle the most flammable of the coating materials being used. Contact the facility manager to request the appropriate fire extinguishers.
  - (4) Signs stating "NO SMOKING" or "NO OPEN FLAMES" shall be conspicuously posted at all paint spray operation areas and paint storage rooms per [29 CFR 1910.107](#) and NFPA 33.
  - (5) Sprinklers protecting spraying areas shall be protected from the accumulation of residue from spraying operations. Per NFPA 33 sprinklers shall be permitted to be covered by cellophane bags having a thickness of 0.08mm or less or by thin paper bags and shall be replaced frequently so heavy deposits do not accumulate.
- c. Paint Spray Booths
- (1) Separation of operations.
    - (a) The use of spark-producing equipment shall be prohibited within 20 feet of a spray booth unless separated by an 1-hour fire rated partition.
    - (b) Spray booths shall be separated from other operations by at least three feet or by a 1-hour rated fire wall.
  - (2) Hot surfaces. Heating appliances, steam pipes, and any other hot surfaces shall not be located in areas where deposits of flammable or combustible residues may accumulate from spraying.
  - (3) Electrical wiring and equipment.
    - (a) There shall be no open flame or spark producing equipment in any spraying area or within 20 feet unless separated by an approved partition.
    - (b) Electrical wiring/equipment not subject to deposits of combustible residues, but located in a spraying area shall be explosion-proof type approved for Class I, Group D locations per [29 CFR 1910.107](#).
    - (c) Unless specifically approved for locations containing deposits of readily ignitable residue and explosive vapors, there shall be no electrical equipment in any spraying area where deposits of combustible residues may readily accumulate. An exception exists for wiring in rigid conduit, boxes, or fittings that do not contain taps, splices, or terminal connections.
    - (d) Portable lamps shall not be used in any spray booth during spraying operations. If portable lamps are used during cleaning or repair operations the lamps must be approved for Class I locations as defined in NFPA 33 or NFPA 70, NEC.

- (e) All metal parts of spray booths, exhaust ducts, and piping systems that convey flammable liquids, combustible liquids, or aerated solids shall be properly grounded in an effective and permanent manner.
  - (f) For electrical wiring and equipment refer to [29 CFR 1910.107](#), NFPA 33 and NFPA 70, NEC, for detailed electrical specifications.
- d. Fixed electrostatic apparatus. Refer to [29 CFR 1910.107](#), NFPA 33 and NFPA 70, NEC, for detailed specifications on fixed electrostatic apparatus.
- e. Ventilation.
- (1) Paint spray operation areas in accordance with provisions of [29 CFR 1910.107](#) and NFPA 33 must be provided with mechanical ventilation that meets NFPA 91 requirements, "Standard for Exhaust Systems for Air Conveying of Vapors, Gases, Mists, and Noncombustible Particulate Solids," and is adequate to remove flammable vapors, gases, or mists to a safe location. The mechanical ventilation shall confine and control combustible residues so they do not present a fire or explosion hazard.
  - (2) The ventilating systems for the spray booth or spray room shall be equipped with interlocks to prevent or stop the spray application equipment from operating unless the exhaust ventilation system is operating and functioning as designed.
  - (3) Mechanical ventilation shall be operated continuously during paint spray operations and for a sufficient time after paint spray operations have stopped in order to allow vapors from drying coated articles and drying finishing material residue to be completely exhausted. Adequate conditioned make-up air shall be provided.
  - (4) The design average air velocity into a spray booth must conform to 1910.94 Table G-10, and 1910.107. Cross drafts must also not exceed recommendations established by these references.
  - (5) The total air volume exhausted through a paint spray booth shall dilute vapors to at least 25 percent of the lower explosive limit (LEL) of the paint/solvent being sprayed.
  - (6) Visible gauges or audible alarms or pressure activated devices shall be installed to indicate or ensure that the required air velocity is maintained. A pressure gauge shall be installed to show the pressure drop across the filters, and the gauge shall be marked to show the pressure drop at which the filters require cleaning or replacement.

- (7) Where the air supply to a spray booth/room is filtered, the fan static pressure shall be calculated with the assumption that the filters are dirty and require either cleaning or replacement.
  - (8) Refer to [29 CFR 1910.94](#) for detailed spray booth ventilation design and construction specifications.
- f. Ventilation Exhaust.
- (1) Permitting. Federal government regulations requires a permit for air emissions from spray paint booths based on the amount of volatile organic compounds (VOC) emitted. State and local permitting requirements may be more stringent than Federal regulations. Facilities/organizations operating spray paint booths are required to determine if permits are required for their spray painting activities.
  - (2) General
    - (a) Exhaust ducts shall be constructed of steel, protected against mechanical damage, properly supported, and shall have a separation of at least 18 inches from combustible materials. If dampers are installed, they shall be maintained so that they will be in a full open position at all times the ventilating system is in operation.
    - (b) Each spray booth shall have an independent exhaust duct system that discharges to the exterior of the building. Multiple cabinet spray booths in which identical spray finishing material is used with a combined frontal area of not more than 18 square feet may have a common exhaust.
    - (c) The design of the exhaust stack must conform with all state and local building and environmental codes. Further, in the District of Columbia, exhaust must be vertically discharged upwards and each stack height must be at least 15 feet high and 5 feet above the roof.
    - (d) Air exhaust from spray operations shall be directed so that it will not contaminate make-up air being introduced into the paint spray operation area or other ventilation intakes. Unless the spray booth exhaust duct terminal is from a water-wash spray booth, the terminal discharge point shall be at least 6 feet from any combustible exterior wall or roof.
    - (e) Where a paint spray booth receives make-up air through self-closing doors, dampers, or louvers, they shall be fully open at all times when the booth or room is in use for spraying. The velocity of air through the doors, dampers, or louvers shall not exceed 200 feet per minute.

- (f) Make-up air to paint spray booths shall be provided. The make-up air shall be clean, fresh air, free of contamination from nearby industrial exhaust systems. Make-up air shall be supplied to spray booths/rooms in a quantity equal to the volume of air exhausted from the booth/room.
  - (g) Refer to [29 CFR 1910.107](#) for specifications on the exhaust fan-rotating element, motor, and belts.
  - (h) The replacement air during the heating seasons shall be maintained at not less than 65°F at the point of entry into the paint spray booth. Temperature shall be regulated as provided in ANSI Z9.2-2006 when otherwise unheated make-up air would be 10°F below room temperature. Heating make-up air shall not be permitted from inside a spray booth. Refer to [29 CFR 1910.94](#) for detailed information on design specifications if make-up air is heated by coal, oil, or gas.
  - (i) Refer to section E. "Inspections and Maintenance," for ventilation exhaust duct inspection information.
- g. Electrical.
- (1) Electrical wiring and electrical utilization equipment that is used in the spray area or in the vicinity of the spray area shall meet the requirements of NFPA 70, National Electrical Code, Article 500, and all applicable requirements stipulated in NFPA 33, "Spray Application Using Flammable and Combustible Materials."
  - (2) No employee shall install or modify any electrical wiring in areas where spray operations occur.
  - (3) Electric motors for exhaust fans must not be placed inside booths or ducts.
- h. Storage and Handling of Flammable and Combustible Paint Materials.
- (1) **Exemption. Storage of water-based latex paint are exempt from these storage requirements.**
  - (2) Quantity. The quantity of paints, lacquers, thinners, solvents, and other flammable and combustible liquids kept near paint spray operations shall be the minimum required for one day's operations. The quantity of these materials shall not exceed a one-day supply.
  - (3) Storage
    - (a) Portable containers of flammable/combustible liquids shall be stored in a separate building, in approved flammable liquid storage cabinets, or in a flammable liquid storage room that meets the requirements of NFPA 30, Flammable and Combustible Liquids Code.



- (b) Flammable/combustible liquids shall be stored in approved fire-resistant safety containers equipped with flash screens and self-closing lids.
  - (1) Bulk storage of flammable/combustible liquids shall be in a separate building, detached from other buildings, or in rooms specifically designed and constructed to meet flammable storage room requirements.
  - (2) Storage of open containers shall be prohibited. Open containers may only be used to clean painting materials, and then the solvent must be transferred back to a closed container for storage or disposal.
  - (3) Storage of compressors, hoses, paint pressure tanks, and spray guns shall be in areas designated by the supervisor and the organizational Safety Coordinator.
  - (4) Pressurized aerosol paint spray cans are flammable materials and they shall be stored in the same manner as other flammable paint materials.
- (c) Handling of containers. Original closed containers, approved portable tanks, approved safety cans, or a properly arranged system of piping shall be used for bringing flammable/combustible liquids into paint spray finishing rooms. Open or glass containers shall not be used.
- (d) Spray containers.
  - (1) Containers with spray nozzles shall be the closing type, or shall be provided with metal covers that shall be kept closed.
  - (2) If a container is not resting on the floor, it shall be kept on metal supports or suspended by wire cables.
  - (3) Gravity-flow spray nozzle containers shall not exceed a capacity of 10 gallons (38 liters).
  - (4) Original shipping containers shall not be subject to air pressure for supplying spray nozzles.
  - (5) Containers under air pressure-supplying spray nozzles shall be:
    - (a) Of limited capacity (not exceeding the capacity necessary for one day's operation);
    - (b) Designed and approved for this type of use; and
    - (c) Provided with a visible pressure gauge and relief valve.
- (e) Liquid transfer
  - (1) The withdrawal of flammable/combustible liquids from containers having a capacity of greater than 60 gallons (227l) shall be by

Factory Mutual (FM)-and United Laboratories (UL) illustrated approved pumps.

- (2) The withdrawal and filling of flammable/combustible liquids from containers, including portable mixing tanks, shall be done only in a mixing room or in a spraying area when the ventilating system is in operation.
  - (3) Precautions shall be taken to protect against liquid spillage and sources of ignition.
  - (4) Whenever flammable/combustible liquids are transferred from one metal container to another, both containers shall be bonded and grounded. This practice prevents electrical discharge from the accumulation of static charge because of the transfer process.
  - (5) Refer to [Chapter 38, "Fire Prevention"](#), of this *Manual*, for more detailed information on flammable/combustibles.
- (f) Paint mixing shall be performed in designated, adequately ventilated rooms constructed of fire-resistant materials. All sources of ignition shall be prohibited in mixing areas. All electrical fixtures or equipment in or within 20 feet of designated paint preparation areas shall meet the requirements of NFPA 70 for Class I Division 2 locations.
- (g) Pipes and hoses
- (1) Containers or piping equipped with a hose or flexible connection shall be provided with a shut-off valve at this connection. The valve shall be kept shut when paint spray operations are not being conducted.
  - (2) Refer to [29 CFR 1910.107](#) for detailed information on design specifications of paint spray booth pipes and hoses.
  - (3) Refer to section E. "Inspections and Maintenance Section," for hose and coupling inspection information.
- i. Housekeeping and Waste Disposal.
- (1) Good housekeeping is essential to safe operations in paint spray areas. Paint rooms, booths, etc., shall be kept clean, and equipment shall be stored in an orderly manner.
  - (2) All paint spray residue, scrapings, discarded filter pads and rolls, and other paint-related debris shall be immediately removed and disposed of properly. Rags and waste shall be placed in approved self-closing metal containers that are plainly marked to indicate the contents. At the end of each day these containers shall be emptied or removed to an approved location for pick-up and disposal. Refer to [Chapter 29, "Hazardous Waste Management"](#), of this *Manual*, for more detailed information.

- j. Safe Work Practices.
- (1) Never point a paint spray gun at any part of the body. Paint can be hypodermically injected into the body by high operating pressures.
  - (2) High Volume Low Pressure paint (HVLP) spray guns. The use of HVLP paint spray guns is highly recommended. HVLP paint spray guns maintain a 75 percent transfer efficiency at a reduced working pressure, which saves paint/material costs and reduces material losses due to paint over-spray.
  - (3) Do not disconnect the gun from the fluid hose or the hose from the pump until the pressure has been released from the hose. Close off the main line air pressure to the pump, and then bleed off the pressure in the fluid hose by triggering the gun before disconnecting it.
  - (4) When handling the gun (e.g., while changing parts or work positions), hold the gun by the grip and remove your fingers from the trigger, which will prevent the gun from being inadvertently activated. Paint spray guns shall be equipped with trigger guards and a safety lock. The lock must be in the non-operating position except when the gun is in use.
  - (5) Check all hose connections and fittings to make sure they are tight and not leaking. The fluid hose must be designed to withstand the fluid's high pressure. The hose, gun, and pressure vessel shall be equipped with special fittings that are not interchangeable with low pressure fittings.
  - (6) Check the fluid hose to ensure there are no weak or worn spots. Check for deterioration caused by exposure to chemicals or ordinary wear and tear. High-pressure leaks from the hose or from the connections can also cause hypodermic injection.
  - (7) Ensure the fluid hose does not contact moving parts of machinery, lie over or around sharp edges and corners, or come near any other potentially damaging items.
  - (8) Never pass a finger over the spray gun orifice to clean it; hypodermic injection of paint into your finger may result. Consult the manufacturer's operating manual for cleaning procedures.
  - (9) The spray gun and the item to be painted shall be grounded to prevent static electricity from being created. Periodic continuity checks shall be performed to ensure the ground wire remains intact.
  - (10) Do not stand downwind of the object being sprayed. A turntable or similar device shall be used to facilitate access to all sides of an object without placing the worker between the object and the exhaust filters.

- (11) To prevent the accumulation of explosive vapors, or the release of toxic vapors into the work area outside of the spray operation, freshly painted items shall be dried in the spray booth or spray area with its exhaust ventilation operating.

## **E. Inspections and Maintenance**

1. Preventative maintenance program shall be implemented to cover periodic inspection and testing of all paint spray booth components and equipment. See [Chapter 35, "Fire Systems Inspection, Testing, and Maintenance"](#) Attachment 17, of this *Manual*, for a list of maintenance requirements.
2. Unit supervisors shall establish procedures whereby ducts are inspected for spray deposits at least yearly and more frequently if operations so dictate. The inspections shall be performed by competent personnel who have knowledge of the equipment and the inherent characteristics of the material(s) used.
3. Air velocity across the face of the booth shall be tested annually by OSHEM and meet the performance criteria specified in [Chapter 27, "Ventilation for Health Hazard Control"](#), of this *Manual*.
4. Filter pads and rolls shall be inspected and changed to ensure proper airflow and protection of ducts from particulate overspray residue. Filters shall be cleaned or replaced whenever the air flow through the face of the booth falls below the velocity requirements.
5. Pressure hoses and couplings shall be inspected at least once per month. Inspectors shall test the hose and couplings with the hose extended, using the "in-service maximum operating pressure." Any hose showing material deterioration, signs of leakage, or weakness in its hose or at a coupling shall be immediately removed from service, and either discarded or tagged with a "Do Not Use" sign until repairs are made.
6. Pressure equipment used in paint spray operations is hazardous because of the compressed air component. The supervisor shall be responsible for ensuring workers are servicing their equipment. Workers shall ensure equipment remains in serviceable condition. Defective, worn, or damaged equipment shall be immediately removed from service, and either discarded or tagged with a "Do Not Use" sign until repairs are made.
7. Cleaning. Paint spray operation areas shall be cleaned daily to remove the accumulation of deposits of combustible residues. Cleaning tools shall be made of non-sparking material.
8. Cleaning solvents. See section C. Hazard Identification and D. Hazard Controls, (b)(2) Fire Protection/Prevention.

## **F. Personal Protective Equipment (PPE) and Personal Hygiene**

1. Eye protection must be worn during spray painting operations. The MSDS must be referenced to select the appropriate eye protection (e.g., goggles, face shield, safety glasses).
2. Eye glasses or goggles with a face shield shall be required during scraping or paint preparation (e.g., abrasive techniques).
3. Consult individual MSDS and contact the Safety Coordinator for assistance with the following specific PPE requirements:
  - a. Hand protection, chemical resistant gloves;
  - b. Protective clothing;
  - c. Respiratory protection. Respiratory protection shall be worn during spray operations. When an operator is in a booth down stream of the object being sprayed, an air-supplied respirator must be used by the employee. Refer to [Chapter 18, "Respiratory Protection"](#), of this *Manual* for instructions on proper selection of respiratory protection.
  - d. Refer to [Chapter 17 "Personal Protective Equipment"](#), of this *Manual*, for detailed information on PPE selection, use, and maintenance.
4. Personnel must change clothing if it becomes contaminated with paint spray chemicals in order to minimize skin contact. Employees' clothing shall not be left on the premises overnight unless kept in metal lockers.
5. Personnel shall wash their hands, face, and any other affected areas prior to eating, drinking, smoking, applying cosmetics, or using the rest room.
6. Eating, drinking, smoking, and applying cosmetics shall be prohibited in the paint spray operation areas.
7. An emergency eyewash station shall be located in the immediate vicinity of each paint spray operation and the hazardous material storage area. The eyewash station must be capable of providing 15 minutes of continuous flushing with potable water. Emergency eyewash stations shall be kept clear and unobstructed.

## **G. Training**

Employees who are expected to use spray operations equipment shall be trained by their supervisor in the safe handling and proper use of all equipment and materials associated with paint spray operations, prior to

their use. The employee shall also be oriented to the location(s) and proper use of all emergency, safety, and PPE they may be required to use in their work performance.

## **H. Records and Reports**

1. Inspection records shall be maintained for at least five years by the supervisor responsible for the paint spray booth and operation.
2. Records should be made available upon request, and at a minimum include the equipment identifier, inspection or procedure performed, date performed, and technician performing the work.
3. Written and updated Job Hazard Analyses and Workplace Hazard Analyses shall be made available for review.

## **I. References**

1. Title 29 (Labor), Code of Federal Regulations (CFR), [Part 1910.94](#) [Occupational Safety and Health Administration (OSHA)] Standard, "Ventilation."
2. Title 29 CFR [Part 1910.107](#), OSHA Standard, "Spray Finishing Using Flammable and Combustible Materials."
3. Title 29 CFR [Part 1910.134](#) OSHA Standard, "Respiratory Protection".
4. National Fire Protection Association (NFPA) 10, "Portable Fire Extinguishers"
5. NFPA 30, "Flammable and Combustible Liquids Code."
6. NFPA 33, "Standard for Spray Application Using Flammable or Combustible Materials."
7. NFPA 70, "National Electrical Code (NEC)."
8. NFPA 77, "Recommended Practice on Static Electricity."
9. NFPA 91, "Standard for Exhaust Systems for Air Conveying of Vapors, Gases, Mists, and Noncombustible Particulate Solids."
10. American Council of Government Industrial Hygienists (ACGIH) Handbook
11. International Code Council's, "International Fire Code."
12. American National Standards Institute (ANSI) Z9.2-2006 "Fundamentals Governing the Design and Operation of Local Exhaust Ventilation Systems".