NFPA 33
Standard for Spray Application Using Flammable or Combustible Materials

Alberta Safety Codes Council

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Agenda

• Introduction

• NFPA 33
  – Scope and Key Definitions
  – Location, Design and Construction
  – Electrical and other Ignition Sources
  – Ventilation
  – Storage, Protection
  – Operations and Maintenance

• Questions and Answers
NFPA 33 Scope

Applies to the spray application of flammable or combustible materials by:

- Compressed air atomization
- Airless or hydraulic atomization
- Electrostatic application
- Other atomized application methods
Scope

This standard also applies to the application of flammable or combustible materials applied by:
- Fluidized bed application methods.
- Electrostatic fluidized bed application methods.
- “Other” means of fluidized application.

Also...
- Automated Electrostatic Spray Equipment.
- Handheld Electrostatic Spray Equipment.
- Drying, Curing and Fusion Processes.
- Organic Peroxides and Plural Component Coatings.
- Styrene Cross-Linked Composites Manufacturing (Glass Fiber-Reinforced Plastics)
Scope

Applies to spray application of water-borne, water-based, and water-reducible materials that:

- Contain flammable or combustible liquids.
- Produce combustible deposits or resin.
This standard **does not apply** to:

- Spray applications performed outdoors.
- Portable spraying equipment.
- Aerosol products up to 1 Liter over 8 hour period.
- Application of noncombustible materials.
- Address toxicity or industrial health and hygiene.
Does NFPA 33 Apply?

- Is this a spray application process? No → Is the application by fluidized means? Yes → NFPA 33 applies. No → Does it involve flammable or combustible materials or produce combustible residues? Yes → Is more than 1 L (1 qt) of material sprayed in 8 hours? Yes → Are these operations performed outdoors? Yes → NFPA 33 applies. No → Is the spraying done with small, portable equipment not being used repeatedly in the same location? Yes → Is the material sprayed from aerosol containers less than 1 L (1 qt) in size and not used repeatedly in the same location? Yes → NFPA 33 applies. No → NFPA 33 does not apply.

FIGURE A.1.1.1 Decision Tree — Does NFPA 33 Apply?
Definitions - Combustible vs. Flammable
Definitions – Combustible Dust
Definitions - Areas

• **Ambient** - the temperature range of the air in the spray area at which a spray application process takes place.

• **Flash-Off Area** - An open or enclosed area after a spray application process where vapors are released due to exposure to ambient air or a heated atmosphere.

• **Spray Area** - Any area in which dangerous quantities of flammable or combustible vapors, mists, residues, dusts or deposits are present due to the operation of spray processes (any area in the direct path of a spray application process, the interior of a spray booth or spray room, the interiors of the exhaust plenum, eliminator/scrubber section, exhaust duct or stack). **AHJ authorizes**
Definitions - Areas

• **Outdoor Spray Area**
  - Outside confines of building
  - May have a canopy or roof that does not impede dissipation of heat or vapours
  - Does not restrict FF access and control

• **Unenclosed Spray Area**
  - Any spray area that is not confined by a limited finishing workstation, spray booth, or spray room,
Definitions

- **Fluidized Bed** - A chamber holding powder coating material that is aerated from below to form an air-supported, expanded cloud of the powder.

- **Electrostatic Fluidized Bed** - Similar to above but the powder is electrically charged with a charge opposite to that of the object being coated.

- **Nonincendive** - Electrical equipment and associated wiring that are incapable, under normal operating conditions, of releasing sufficient electrical or thermal energy to cause ignition of specific hazardous materials in their most easily ignited concentrations in air.
Definitions

• **Overspray** - Any sprayed material that is not deposited on the intended object.

• **Spray Booth** - Power-ventilated enclosure for spray application operation or process **confines and limits** escape of material being sprayed, including vapors, mists, dusts and residues and conducts or directs these materials to an exhaust system. The booths can be of the Dry, or Water-Wash type.
Definitions

• **Spray Room** - A power ventilated fully *enclosed* room used exclusively for open spraying of flammable or combustible materials.

• **Ventilation** - Movement of air that is provided for the prevention of fire and explosion and is sufficient to prevent accumulation of vapor-air mixtures in concentrations over 25% of the lower flammable limit.
Location

- Spray application operations and processes shall be confined to spray booths, spray rooms, or spray areas.
- Conveyor Systems
- Building to building
- Spray application operations and processes shall not be conducted in
  - Assembly, educational, Institutional or Residential any A, E, I or R occupancy...
  - unless they are located in a room that is separated by 2 hour fire rated construction (vertical and horizontal) and protected by an approved automatic fire sprinkler system.
Location

• Should be arranged for adequate egress for personnel and adequate access for fire-fighting operations.
• If extensive, should be separate building or area that’s separated by fire-rated construction.
Location

- **Assembly lines or conveyor systems** present special problems.
  - If extended between separate buildings, a non-combustible or limited-combustible, sprinkler-protected enclosure or passageway might be of value.
  - Pass through fire walls or fire partitions, will be difficult to reliably protect
  - If conveyor systems pass through floors, openings should be surrounded by deep [greater than 460 mm (18 in.)] draft curtains on the underside of the floor deck
  - Automatic high-velocity spray nozzles arranged to create a counter draft should be considered.
- **Sprinklers**
Location

• Automatic-closing fire doors.
  – Provide non-combustible or limited-combustible, sprinkler protected tunnel on both sides of the opening.

• Where operations occupy one portion of an open area, should be surrounded by non-combustible or limited-combustible draft curtains min. 460 mm (18 in.) from ceiling, but deeper if practical.

• Sprinkler discharge should be drained to outside internal drain system, or to some other suitable location.

• Properly designed/installed floor drains/scuppers sufficient in number and size to handle expected sprinkler discharge should be provided.
Location

• Where operations located on upper floors,
  – Should not be located directly above goods or equipment subject to water damage.
  – Floor should be made watertight and means should be provided to drain sprinkler discharge directly from the area.

• Spray application operations **should not be located in a basement area.**
Design and Construction

• Construction
  – Walls, doors, ceilings and floors shall be constructed of noncombustible or limited combustible materials with interior surfaces smooth (cannot trap residue or restrict ventilation or cleaning).

• Filters
  – When part of wall or ceiling - Class 1 or Class 2
  – As per ANSI/UL900 – Standard for Air Filter Units

• Aluminum not to be used unless limited to ancillary devices. (eg. Platforms, Spray Equipment)
Design and Construction

- Spray **Rooms** constructed and separated from surrounding areas with **1 hour fire rated construction**.
- Enclosed spray booths/rooms must have means of **egress compliant with NFPA 101**.
- **Conveyor openings** for transporting or moving work into and out of spray area shall be as small as practical.
Design and Construction

- Spray **booths** Separation
  - separated from other operations by a minimum distance of **915mm** (3 ft) or by a partition, wall, or floor/ceiling assembly with a **minimum 1 hour fire resistance rating**.

- All parts must be **readily accessible for cleaning**.

- A clear space of not less than **915mm** (3 ft) shall be maintained on all sides and above.
  - Some exceptions
    - 1 hour fire rating between walls and booth can be maintained and cleaned
    - May be nearer to exterior wall/roof of non-combustible material and it can be maintained and cleaned

- Movement of vehicles in or out prohibited until
  - Spray Operations cease
  - Proper ventilation occurs and maintained
Design and Construction

- **Panels for light fixtures** or observation shall be
  - heat-treated glass,
  - laminated glass,
  - wired glass, or
  - hammered wired glass and
- Listed assemblies permitted
- **Sealed to confine vapours**, mists, residues, dusts and deposits to the spray area.
- **Panels for the light fixtures** shall be separated from the fixture to prevent the surface temperature of the panel from exceeding 93°C (200°F)
Design and Construction

- **Spray areas** that are equipped with ventilation distribution, baffle plates, or with dry overspray collection filters shall:
  - Have distribution plates or baffles constructed of **noncombustible materials** and be readily accessible for cleaning.
  - **Not use filters** when applying materials known to be **highly susceptible** to spontaneous heating/ignition.
  - Have **filter supports** constructed of **noncombustible materials**.
  - Have **filters readily accessible** for cleaning or replacement.
  - **Not allow filters to be alternately used** for different types of coating materials.
Electrical and Other Sources of Ignition

Electrical wiring and utilization equipment

Takes into consideration:

- The location and use where flammable gas or vapor is present or might be present in the air in quantities sufficient to produce an explosive or ignitable mixture.
- Where condition can exist frequently due to repair or maintenance operations, or leakage.
- Breakdown or faulty operation of equipment can release ignitable concentration with potential simultaneous failure of electrical equipment in such a way that it becomes a source of ignition.
- Static Electricity Control

- Qualified Electrician should be used/consulted during inspection and commissioning
Electrical and Other Sources of Ignition Simplified – Maybe?

- Standard references a Class, Division and Zone System to identify different levels of required protection
- Classes differentiate between Flammable gas or vapour and Combustible dust
- Divisions and Zones based on
  - Combustibility/Flammability of Atmosphere
  - Used to identify location, proximity, and isolation from, electrical hazards
    - Switches/Fixtures
    - Lighting
    - Mechanical parts and machinery
    - Heating, etc.
  - Way of varying protective measures based on hazard class
    - Qualified Electrician or Electrical Inspector should be used during inspection and commissioning
- Division System used in NFPA 70 – Zone System used in accordance with International Electrotechnical Commission (IEC) – NFPA recognizes both 1996
Electrical and Other Sources of Ignition
Simplified – Maybe?

• Classes
  – Class I – any location where flammable gas or vapours are or may be present sufficient to produce an explosive or ignitable mixture
  – Class II – any location that may be hazardous due to presence of combustible dust

• Division System
  – Division 1 – Ignitable gases or Vapours are always present or likely to be present
  – Division 2 – Ignitable gases or vapours are not normally present

• Zone system identifies hazardous locations as
  – Zone 0 – Ignitable Atmosphere is always present
  – Zone 1 – Ignitable Atmosphere is likely to be present
  – Zone 2 – Ignitable Atmosphere is not normally present
  – Zone 20 – Ignitable concentration of combustible dust is always present
  – Zone 21 – Ignitable concentration of combustible dust is likely present
  – Zone 22 – Ignitable Atmosphere is not normally present
Electrical Devices – Why this is important?

- Spray area shall be
  - Class I, Division 1;
  - Class I, Zone 1;
  - Class II, Division 1; or
  - Zone 21 (whichever is applicable).

- All electrical equip and wiring in Spray Area – whether subject to combustible residues or not shall be in compliance with requirements of above.
Electrical Devices

Equipment and wiring located outside but within 6.1m (20 ft) horizontally and 3.5m (10 ft.) vertically of an unenclosed spray area shall be designated.
Electrical Devices

Any spray application operations conducted in a closed-top, open-face or open-front booth, or room, any electrical wiring or equipment located outside the booth/room but within 915mm (3 ft) of any opening shall be Class I, Division 2; Class I, Zone 2; or Zone 22 locations as applicable.
Electrical Devices

- If spray application operations are confined to an enclosed spray booth or room, electrical area classification shall be as follows:

- Area within 915 mm (3 ft) of any opening shall be classified as Class I, Division 2; Class I, Zone 2; Class II, Division 2; or Zone 22 locations, whichever is applicable.
Miscellaneous Electrical

- Light fixtures outside the spray area shall be listed for use according to the area they occupy.
- All electrically conductive objects in the spray area shall be electrically connected to ground.
- Portable electric light fixtures shall not be used in any spray area while spray application operations are being conducted.
Static Electricity

- All electrically conductive objects in spray area, except those objects required by the process to be at high voltage, shall be:
  - electrically connected to ground with a resistance of not more than 1 megohm (10^6 ohms).
  - Applies to containers of coating material, wash cans, guards, hose connectors, brackets, and any other electrically conductive objects or devices in the area.
  - Also applies to any personnel who enter the spray area.
Miscellaneous Electrical

• Flexible Power Cords are permitted for use if;
  – Approved for extra hard usage
  – Equipped with grounding conductor
  – Connected to terminals and conductors in approved manner
  – Supported by positive metal clamp – prevents strain on cord
  – Explosion proof seals for liquid or dust

• Portable Electric Lights
  – Not permitted while spray operations are being conducted
Ventilation

Ventilating and exhaust systems shall be designed and installed in accordance with the applicable requirements of

Ventilation
Ventilation

Each spray area shall be provided with mechanical ventilation that is capable of:

- Confining and removing vapors and mists to a safe location.
- Confining and controlling combustible residues, dusts and deposits.
- Concentration of vapors and mists in the exhaust stream of the ventilation system shall not exceed 25% of the lower flammable limit.
- Minimum - Three air exchanges per hour (One Air Exchange every 20 min)
Ventilation

- Mechanical Ventilation shall be kept in operation at all times while spray operations are being conducted, and for a sufficient time thereafter to allow vapors to dissipate from drying coated objects.

- Adequate supply of clean make-up air shall be provided to compensate for the air exhausted from spray operations (shall not recirculate exhaust air).
Ventilation

Air exhausted to the atmosphere from liquid spray operations shall be conducted by **ducts directly to the outside of the building**, and:

- Shall follow the **most direct route** to the point of discharge.
- No penetration of fire walls
- Shall be directed **away from any fresh air intakes**.
- The discharge point shall be **at least 1.8m (6 ft)** from any exterior wall or roof.
- Shall **not discharge in the direction of any combustible construction** within 7.6m (25 ft) of the discharge point (or any unprotected opening).
Ventilation

- Use caution when allowing recirculation of exhausted air under specific circumstances.
- Exhaust ducts shall not be manifolded together.
- Exhaust plenums and ducts shall be constructed of steel (smooth concrete allowed).
- Exhaust ducts shall be supported to prevent collapse under fire conditions (The weight of residue and fire sprinkler discharge must be taken into account).
- All exhaust ducts shall be provided with doors, panels, or other means to facilitate inspection and maintenance.
Ventilation - Recirculation

- Recirculation shall be allowed only for unmanned spray operations and for cascading to subsequent unmanned spray operations.
- Solid particulates shall be removed from the recirculated air.
- The concentration of vapors in the exhaust airstream shall not exceed 25 percent of the lower flammable limit.
- Listed equipment shall be used to monitor the concentration of vapors in all exhaust airstreams.
- The equipment shall sound an alarm and automatically shut down spray operation if the concentration of any vapour in the exhaust airstream exceeds 25 percent of the lower flammable limit.
- All equipment installed to process and remove contaminants from the air exhausted from spray operations shall be approved.
Storage, handling, and mixing of flammable and combustible liquids shall meet all the applicable requirements of **NFPA 30, Flammable and Combustible Liquids Code**

- For large spray operations, coatings, thinners, and solvents can be stored in one of the following locations:
  - Underground storage tanks
  - Aboveground storage tanks
  - Separate buildings
Storage and Handling

• For smaller operations, separate storage and mixing areas might not be justified.

• Desirable to minimize the fire loading in or near the spray area by one or a combination of the following methods:
  – Flammable liquid storage cabinets
  – A protected enclosed metal structure
  – Use of metal containers with limitations on the quantity of liquid located near the spray area
As per NFPA 30 - Total aggregate volume of above listed liquids in grouped storage cabinets shall not exceed the Maximum Allowable Quantity (MAQ) of flammable and combustible liquids per control area.

See Table in Standard
Storage and Handling

- Industrial Occupancies shall not exceed the MAQ per control area.
- Allowable quantity of liquid located in vicinity of spraying operations but outside of identified storage areas shall not exceed the amount required to supply spraying operations for one continuous 24-hour period, or as per table 8.2.1.2.
- Notes reflect conditional increases such as:
  - Storage in approved cabinets
  - Increases for sprinkler protection

| Table 8.2.1.2 Maximum Allowable Quantity of Flammable and Combustible Liquids per Control Area |
|-----------------------------------------------|----------------|--------|---------|
| **Liquid Classes** | **Quantity** |       | **Notes** |
| Flammable liquids |                |       |         |
| IA               | 115            | 30    | 1, 2    |
| IB & IC          | 460            | 120   | 1, 2    |
| IA, IB, IC combined | 460         | 120   | 1, 2, 3 |
| Combustible liquids |                |       |         |
| II               | 460            | 120   | 1, 2    |
| IIIA             | 1,265          | 330   | 1, 2    |
Mixing

Mixing rooms shall meet all of the following requirements:

- Shall meet the construction requirements of Construction Chapter (Ch. 5)
- The area shall not exceed 14m. sq. (150 ft. sq)
- Shall be designed to contain a spill of the contents of the room.
- Shall be provided with continuous mechanical ventilation and shall be in operation at all times.
- Shall have same electrical classification as an enclosed spray booth.
- Shall be provided with an approved automatic fire protection system. NFPA 13
- Shall be provided with portable fire extinguishers in accordance with NFPA 10
Mixing

- The amount of liquid permitted in a single spray area shall not exceed 227L (60 gal).
- Where a separate mixing room is provided and located within 1.8m (6 ft) of an adjacent spray area, the combined quantities of liquids shall not exceed 454L (120 gal).
- Where a separate mixing room is provided and is located more than 1.8m (6 ft) from adjacent spray area, quantity of liquid permitted in mixing room shall not exceed 80L/m sq (2 gal/ft. sq) (maximum 1135L (300 gal)), spray area shall not exceed 227L (60 gal)… or half permitted amount.
Protection

Spray areas, which include by definition any

- associated exhaust plenums and exhaust ductwork,
- particulate filters, any
- solvent concentrator units,
- recirculation air supply units, and
- mixing rooms,

Shall be protected with **an approved automatic fire protection system.**
Protection

Automatic Sprinkler Systems design shall take the following into consideration.

Shall be:

- a wet pipe, dry pipe, pre-action, or open-head deluge system (whichever is most appropriate).

- designed for NFPA 13 - 5.4.2 Extra Hazard (Group 2) occupancies.

- Water supply shall be sufficient to supply all sprinklers likely to open without depleting the available water for firefighting hose streams.
Protection

The automatic fire protection system shall be permitted to be, and shall be installed in accordance with, any of the following:

- An automatic water sprinkler system (NFPA 13).
- An automatic foam water sprinkler system (NFPA 16).
- A carbon dioxide extinguishing system (NFPA 12).
- A dry chemical extinguishing system (NFPA 17)
- A gaseous agent extinguishing system (NFPA 2001)
Protection

For continuous spray application operations, activation of the automatic fire protection system shall automatically accomplish all of the following:

- **Activate a local alarm** in the vicinity of the spraying operation.
- **Transmit an alarm signal** to the facility’s fire alarm system.
- **Shut down** the coating material delivery system.
- **Shut down** all spray application operations.
- **Stop any conveyors** into and out of the spray area.
Protection

- System shall be controlled by a separate listed indicating valve, operable at floor level.
- Stacks and exhaust ducts shall be provided with access openings for inspection and cleaning of sprinklers.
- Sprinklers shall be protected against overspray residue, either by location or covering.
- Permitted to be covered by cellophane ≤ .08mm thickness or thin paper bags.
- Sprinklers that have been painted or coated by overspray shall be replaced with new sprinklers.
Protection

- Automatic Carbon Dioxide, Dry Chemical, and Clean Agent Systems shall be capable of discharging its contents into the entire protected area simultaneously, including the exhaust plenum and exhaust ductwork.

- Portable fire extinguishers shall be provided and located in accordance with NFPA 10, *Standard for Portable Fire Extinguishers*. 
Protection

- Automated powder application equipment, and Automated liquid electrostatic spray application equipment, both listed and unlisted, shall be further protected by listed optical flame detection, installed and supervised in accordance with NFPA 72, *National Fire Alarm and Signaling Code*.

- This action shall stop
  - all processes and conveyors,
  - shut down ventilation and electrical equipment,
  - activate the automatic protection system.
Operations and Maintenance

- Maintenance procedures shall be established to ensure that all spray application apparatus and processes are operated and maintained in accordance with the manufacturers’ specifications and the requirements of this standard.

- **Maintenance** shall be the responsibility of the users of the apparatus and processes.
Operations and Maintenance

• All spray areas shall be kept free of excessive accumulation of deposits of combustible residues.
• General good housekeeping practices
• If residue accumulates to excess in booths, ducts, or duct discharge points, or other spray areas, all spraying operations shall be discontinued until conditions have been corrected.
Operations and Maintenance

• **Maintenance procedures** shall be established to ensure that **overspray collector filters are replaced before excessive restriction to airflow occurs**.

• At the **close of the daily operation**, all discarded **overspray collection filters, residue scrapings, and debris contaminated with residue shall be removed and placed in a noncombustible container with a tight fitting lid** in a designated storage location.
Operations and Maintenance

- Approved waste containers shall be provided wherever rags or waste are impregnated with sprayed material, and all such rags or waste shall be deposited therein immediately after use.

- Employee clothing contaminated with sprayed material shall not be left on the premises overnight unless kept in a metal locker.
Training

All personnel involved in the spray application processes covered by this standard shall be instructed in the following:

- Potential safety and health hazards.
- Operational, maintenance, and emergency procedures required.
- Importance of constant operator awareness.
Training

• Personnel required to handle or use flammable or combustible materials shall be instructed in the safe handling, storage, and use of the materials, as well as emergency procedures.

• All personnel required to enter or to work within confined or enclosed spaces shall be instructed as to the nature of the hazard involved, the necessary precautions to be taken, and the use of protective and emergency equipment required.
Training

- All personnel shall be instructed in the proper use, maintenance, and storage of all emergency, safety, or personal protective equipment that they might be required to use in their normal work performance.

- Documentation shall be employed to record the type and date of the training provided to each individual involved in these processes.
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Questions