

CORPORATE FIRE PREVENTION AND PROTECTION BULLETIN #3-02

DESIGN, CONSTRUCTION, INSTALLATION, OPERATION AND MAINTENANCE OF EXHAUST SYSTEMS

This special bulletin addresses the design, construction, installation, operation, and maintenance of exhaust systems for air conveying of vapors, gases, mists, noncombustible particulate solids and combustible particulate solids.

REQUIREMENTS

- I. Design, Construction and Installation
 - A. Dissimilar materials should not be handled through a common exhaust system when their intermingling would create a fire or explosion hazard in the duct.
 - B. Operations generating flames, sparks, or hot materials, such as from grinding wheels and welding, should not be consolidated in the same exhaust system that air conveys flammable or combustible materials, unless inherent to the single process.
 - C. Exhaust systems designed to air convey flammable or combustible materials that can contain foreign ferrous materials, should have magnetic separators installed at those points where the ferrous materials enter the system.
 - D. Exhaust systems utilizing combustible components should be used only to handle noncombustible environments.
 - E. Ducts preferably should not penetrate walls or floors serving as fire subdivisions. However, if penetration is necessary, the following should be provided.
 1. Ducts that pass through a fire barrier having a fire resistance rating of 2 hours or more should meet the following:
 - a. Openings for ductwork should be protected with a listed fire damper located in the plane of the fire partition. The damper should have a minimum fire

rating equal to that of the fire barrier. The damper should be arranged for automatic closure by activation by a rated detector at 50°F (27°C) above ambient temperature.

- b. Be constructed and supported so that 10 ft (3 m) of the duct on each side of the fire barrier can resist a 2 hour fire scenario.
 - c. Be protected by sealing the opening around the duct with a listed or approved material of a fire resistance rating equivalent to that of the fire barrier.
2. Ducts that pass through a required fire barrier having a fire resistance rating of less than 2 hours should meet the following:
- a. Openings for ductwork should be protected with a listed fire damper located in the plane of the fire partition. The damper should have a minimum fire rating equal to that of the fire barrier. The damper should be arranged for automatic closure by activation by a rated detector at 50°F (27°C) above ambient temperature.
 - b. Be protected by sealing the opening around the duct with a listed or approved material of a fire resistance rating equivalent to that of the fire barrier.
- F. Duct supports should be designed to carry the weight of the duct system itself, plus the anticipated weight of any residues. If sprinkler protection is provided inside the duct system, then the duct supports also should be designed to carry the anticipated weight of any accumulation of sprinkler discharge.
- G. When sprinklers are installed, drains sized for the anticipated sprinkler discharge should be provided at low points to reduce the possibility of duct collapse due to accumulation of sprinkler water. Both horizontal and vertical duct runs should be considered in the drainage design. Where the occupancy is susceptible to water damage, drains should be arranged to discharge at a safe location. In ducts where hazardous residue is present, drains should be arranged for proper disposal of wastes in the drain water.

- H. All metal parts of ducts or other apparatus used for the removal of flammable gases or vapors, or for conveying combustible dust, stock or refuse, should be electrically bonded and the duct system grounded. When metallic contact is broken at duct joints or at other points, metal straps should be installed to afford effective bonding connections.
- I. Fans assemblies shall be installed in accordance with the applicable NFPA standards and the manufacturer's instructions.

II. Inspection Access

- A. Access doors, panels, or other means should be provided on spacing that would allow inspection, maintenance, cleaning, and access to fire protection devices.
- B. Access doors or panels should be of the same material and of equal or greater thickness than the duct and should be sealed, gasketed, or tightly fitted so that conveyed material will not escape.
- C. Inspections to determine the amount of dust, lint and waste material in the duct system should be established and kept on a regular schedule. The interval between cleanings will depend upon the character of the deposits and the accumulation rate. Combustible deposits thicker than 0.125 inch (3 mm) should be removed.
- D. Sprinklers should be readily accessible for inspection, maintenance and replacement. Sprinklers covered with deposits or corrosion should be replaced.

III. Duct Fire Protection

- A. Unplasticized polyvinylchloride plastic ducts less than ¼ inch (6.3 mm) wall thickness, and ducts FM listed/approved "as not requiring sprinklers" which do not carry combustibles or not having the potential for combustible residue buildup do not require automatic sprinklers within the duct.
- B. The following exhaust systems should be provided with automatic sprinklers:
 - 1. Exhaust systems with cross-sectional areas equal to or greater than 100 in² (645 cm²) utilizing combustible components

2. Exhaust systems with cross-sectional areas equal to or greater than 100 in² (645 cm²) having the potential for interior combustible residue buildup
 3. Exhaust systems for spray application of flammable or combustible materials
- C. Automatic sprinklers should be provided within the duct and at the duct intake, hood, enclosure, or canopy as follows:
1. Sprinklers should be hydraulically designed to provide a density of 0.20 gpm/ft² (8 L/min/m²) over an area equal to the projected area of the duct, but not exceeding 100 lineal feet (30 m) of the duct.
 2. Minimum flow should be 20 gpm (76 L/min) per sprinkler within the 100 (30 m) lineal feet of the duct.
 3. Sprinklers shall be spaced not greater than 12 ft (3.7 m) apart horizontally and vertically. Sprinkler spacing in ducts utilizing combustible components (rather than combustible residue buildup or spray applications) may be increased to not more than 20 ft (6.1 m) horizontally if a density of 0.50 gpm/ft² (20 L/min/m²) over an area equal to the projected area of the duct, but not exceeding 100 lineal feet (30 m) of the duct, can be provided.
 4. Sprinklers should be ½ inch (15 mm) nominal orifice pendent sprinklers rated at least 50°F (27°C) above the operating temperature inside the duct.
- D. Except when approved by the Corporate Fire Protection Staff, steam or gaseous extinguishing systems should not be used as the primary protection system for ducts in lieu of automatic sprinklers.
- E. Specifications for gaseous extinguishing systems should be prepared under the supervision of a person fully experienced and qualified in the design of systems and with the advice of the Corporate Fire Protection Staff.
- F. When large ducts, plenums or other associated equipment contain fixed arrays of filtering or pollution control features, which are combustible or which would accumulate combustible materials, an automatic extinguishing system should be provided.

- G. When the duct width or diameter is greater than 4 ft (1.2 m), sprinklers should be installed below the duct.
- H. When the duct width or diameter is greater than 12 ft (3.7 m), an additional line of automatic sprinklers at the same spacing should be provided inside the duct.
- I. In systems with branch ducts, one sprinkler should be provided in each branch duct within 3 ft (0.9 m) of its point of entry into a main duct system. Several smaller ducts may be manifolded and a single sprinkler provided before the manifold enters the main duct system. Where not practical due to size limitations, a sprinkler may be provided in the main duct at the point where the smaller branch duct enters.
- J. The supply line to the duct sprinklers should be equipped with an accessible indicating type control valve. If there is more than one exhaust duct system, and they can be operated independently, sprinklers to each system should be controlled by separate valves. A separate water flow alarm may be advisable for duct system protection in large installations.
- K. Sprinkler piping should be run outside the ductwork and supported independent of the ductwork system.

IV. Explosion Protection

- A. The concentration of flammable gases, vapors, mists, dusts, or hybrid mixtures within the ventilation system should not exceed 25 percent of the lower flammable limit (LFL) or minimum explosible concentration (MEC) of the material in use.
- B. Exhaust systems with concentrations above 25 percent of the lower flammable limit (LFL) or minimum explosible concentration (MEC) of the material in use should be designed and protected in accordance with NFPA 69, Standard on Explosion Prevention Systems.

V. Corrosive Materials

- A. Corrosion protection should be provided for sprinklers where applicable. The following methods are acceptable contingent upon compatibility with the corrosive properties of the material handled.

The sprinkler manufacturer may be consulted for additional guidance.

Method 1 — Approved Sprinkler Heads

Approved, wax, lead, or wax-over-lead coated sprinklers can be used with or without plastic bags (Method 2). The operating temperature within the duct should not exceed 150°F (66°C).

Method 2 — Plastic Bags

Each approved sprinkler head in the duct can be protected with double polyethylene bags. Each bag should be maximum 4 mils (0.1 mm) thick and arranged to open to the outside the duct. Teflon tape can be applied around the sprinkler deflector to limit abrasion of the bag. The operating temperature within the duct should not exceed 150°F (66°C).

Method 3 — Plastic-Coated Sprinklers

Approved sprinklers and piping coated with epoxy, tetrafluoroethylene (TFE) resin or some other plastic resistant to the corrosive atmosphere.

Method 4 — Special Alloy Sprinklers

Approved sprinklers of metal alloys (such as Inconel, Monel, Hastelloy, etc.) or approved sprinklers of stainless steel can be used. These are effective against certain, but not all, environments. The manufacturers' specifications should be consulted.

VI. Dust Collectors

- A. Provide access ports for all areas of the collector where necessary for effective manual firefighting. For small collectors, portable extinguishers (preferably water-type units) are acceptable. For larger collectors, 1½ inch (38 mm) fire hose with combination nozzle should be available.
- B. Bag type collectors containing combustible dust or particulate should be provided with automatic sprinkler protection in the bag section, in the clean air plenum, and in hoppers shielded from protection in the above areas of a minimum density of 0.20 gpm/ft² (8 mm/min). In the bag area provide a maximum 50 ft² (4.6 m²) head spacing. In the hopper area provide one head per hopper and a maximum 100 ft² (9.3 m²) head spacing. In the clean air plenum provide one head per 100 ft² (9.3 m²). This protection can be provided by either of the following:

1. Automatic sprinkler protection with head temperature rating 50°F (27°C) above the operating temperature inside the duct.
 2. An open-head spray system activated by an infrared or continuous line type detection system. Manual activation of open head sprinklers, in lieu of automatic operation, requires review and approval on a case-by-case basis.
- C. Dust collectors handling combustible material should be located outside buildings whenever possible.
- D. Automatic sprinkler protection is not considered necessary for bag type collectors containing noncombustible dust equipped with a less combustible bag material.

VII. Maintenance

- A. Cutting and welding operations on sections of ductwork with combustible deposits should be done with the duct section removed and cleaned, if practical. If not practical to remove the duct section, the duct should be cleaned thoroughly prior to cutting or welding.
- B. Sufficient 1½ inch (38 mm) fire hose with combination spray nozzles should be available to provide adequate coverage to all duct access doors and panels during cutting and welding operations on ductwork.
- C. Manual extinguishing equipment should be available to personnel performing maintenance on dust collectors.

The Delphi Corporate Fire Prevention and Protection Standards and fire insurance underwriter's recommendations should be used as a basis for protection requirements. In addition, compliance to local code is required where such code exceeds these requirements.