SAFETY AND REGULATORY GUIDELINES

FOR POWDER RECOVERY SYSTEMS AND APPLICATION EQUIPMENT

MICHAEL STREEPEY – NORDSON CORPORATION

ABSTRACT:

There are several agencies – Occupational Safety and Health Administration (OSHA), American National Standards Institute (ANSI), Environmental Protection Agency (EPA), International Fire Code Institute (IFCI), and National Fire Protection Association (NFPA) - whose standards impact the design and operation of powder coating systems. The purpose of this paper is to provide an overview of how these federal, state, and local agencies affect powder coating operations in the United States. Compliance of both new and existing application equipment and cyclone/cartridge technologies with these safety and regulatory standards will be discussed. This paper is not intended to be a substitute for actual OSHA, ANSI, EPA, IFCI, or NFPA standards. Owners or managers of powder coating systems should always refer to the appropriate local, state, and national codes/regulatory agencies.

AGENCIES

Governmental agencies issuing regulations affecting powder painting operations in the United States include the following:

OSHA – The Occupational Safety and Health Administration

"The mission of the Occupational Safety and Health Administration is to save lives, prevent injuries, and protect the health of America's workers." OSHA's goal is to reduce work place hazards, establish rights and responsibilities for employers and employees, implement safety and health recording systems and training programs, develop and enforce work place safety and health standards, and oversee state programs.

EPA – The Environmental Protection Agency

"EPA's mission is to protect human health and to safeguard the natural environment – air, water, and land working for a cleaner, healthier environment for the American people." The EPA is the federal agency that enforces the environmental laws passed by Congress. The EPA is responsible for researching and setting national standards for water/air pollution, solid wastes, and special hazards. The individual states are then

responsible for issuing permits and monitoring /enforcing compliance of the EPA's environmental regulations.

Local Fire Marshall and Industry Safety Department

Fire Marshalls and Industry Safety Departments are responsible for developing, adapting, and enforcing local regulations related to fire and workplace safety. At their discretion, they can select standards from various agencies to comprise fire and workplace safety guidelines for their locale.

CONSENSUS STANDARDS

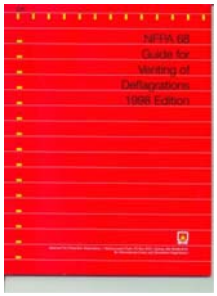
Consensus standards are used to supplement federal, state, and local regulations and must provide equal or greater employee protections than federal laws/regulations. Powder painting operations are affected by the following standards:

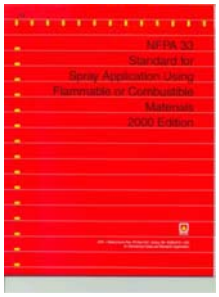
ANSI – The American National Standards Institute

ANSI is a private/nonprofit organization that promotes and facilitates voluntary consensus standards and represents over 1,000 company, organization, government agency, institutional, and international members. ANSI standards are designed to accelerate market acceptance of products with an emphasis on consumer product safety.

NFPA – The National Fire Protection Association

The NFPA is an international nonprofit membership organization with more than 75,000 members representing nearly 100 nations around the world. NFPA serves as the world's leading advocate of fire prevention. Six thousand volunteers from diverse professional backgrounds serve on 230 technical code and standard development committees. During the development of new or revised codes, interested parties are encouraged to provide the NFPA technical committees with input. All NFPA members then have the opportunity to





vote on new and revised codes. NFPA's focus on true consensus has helped the association's code-development process earn accreditation from the American National Standards Institute.

UFC – The Uniform Fire Code

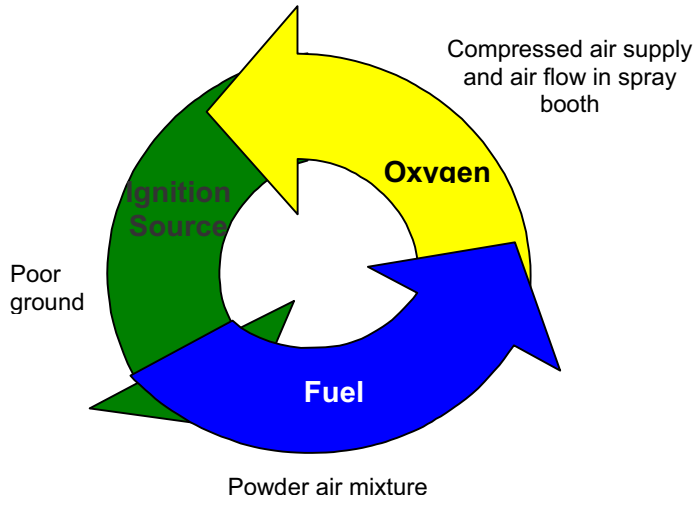
The Uniform Fire Code is a national model fire prevention code developed by the International Code Council. The Uniform Fire Code ensures public safety and fire prevention in and around a building constructed in accordance with the Uniform Building Code.

WHAT CAUSES POWDER PAINT FINISHING FIRES?

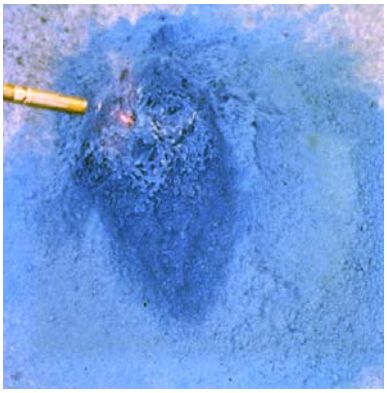
Elements of Combustion – Powder Paint Systems

1. Fuel – Powder Air Mixture
2. Ignition Source – Poor Ground
3. Oxygen – Compressed Air Supply & Air Flow in Spray Booth

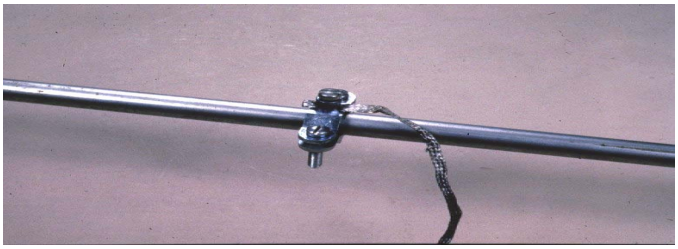
Are Powder Paints Flammable?



Powder paints are considered to be nonflammable. However, powder paints in an atomized state can support a fire.

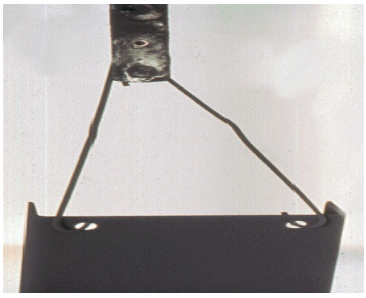


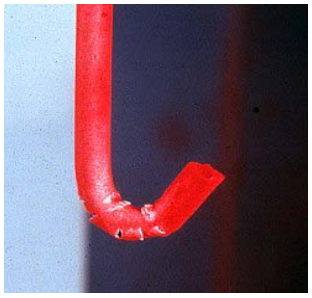
Grounding:



NFPA 33 Chapter 13-6.3 states "All electrically conductive objects in the 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, as measured with an instrument that applies at least 500 volts D.C. to the circuit being evaluated. This requirement also applies to any personnel who enter the area.

Can Poor Grounding Cause a Fire?





Yes! Like ungrounded powder particles, ungrounded equipment will act as a capacitor by storing electrical energy when subjected to an electrostatic field. When the ungrounded substrate is saturated with an electrostatic charge, the object will subsequently discharge this energy to ground causing an arc or spark. If an arc of sufficient energy occurs in an area with the right powder-to-air mixture, it becomes the ignition source that starts a fire. Powder buildup on part fixtures and the conveyor can create a resistance to ground. It is extremely important that the contact points on the conveyor and hanger are cleaned to maintain a 1 megohm resistance to ground.

AUTOMATED & MANUAL ELECTROSTATIC SPRAY EQUIPMENT REGULATIONS AND STANDARDS

NFPA 33 Chapter 9 Automated Electrostatic Spray Equipment

9.5 Spray Equipment shall be listed

Exception No. 1: Spray equipment that was installed prior to December 31, 1997 shall be listed or approved.

Exception No. 2: This requirement shall not apply to automatic electrostatic spray equipment where all of the following additional fire protection is provided:

(a) The flame detection system shall use optical flame detectors. In addition to the requirements in Section 7.6, the optical flame detection system shall also activate an open head deluge system designed to discharge a minimum density of 24.4 mm/min over each affected automated zone.
(b) Manual deluge activation stations shall be installed at each personnel entrance to an automated electrostatic spray zone. These devices shall activate the open head deluge system for the affected automated zone and accomplish the requirements in Section 7.6(2).
(c) A wet pipe sprinkler system shall also be provided throughout the spray booth. This system shall meet all the applicable requirements of NFPA 13, Standard for the Installation of Sprinkler Systems, for Extra Hazard (Group 2) occupancies.
(d) The automated zone open head deluge systems and spray booth wet pipe sprinkler system shall be supplied by separate or dual fed water supply piping.
(e) Automatic electrostatic equipment enclosures containing paint delivery systems shall be protected with an approved automatic fire suppression system. Activation of this system shall automatically accomplish the requirements of Section 7.6(2)

NFPA 33 Chapter 10 Handheld Electrostatic Spray Equipment

10-3 Handheld Apparatus

Handheld electrostatic spray apparatus and devices shall be listed. The high-voltage circuits shall be designed so that they cannot produce a spark that is capable of igniting the most hazardous vapor-air mixture or powder-air mixture likely to be encountered, and so that they cannot result in an ignition hazard upon coming in contact with a grounded object under all normal operating conditions.

What Does Listed Mean?

Listed means that an approved, nationally recognized testing laboratory such as Factory Mutual (FM) Corporation has inspected and approved the device. The device meets safety requirements established by the laboratory, bears the laboratory's mark, and is included in the list of devices that have passed their tests. Periodically, these "listed" products receive manufacturing and quality audits by the agencies on a regular basis.

What is the Difference Between "Listed" and "Approved" Equipment?

Listed, as described above, means the device has passed tests established by an approved, nationally recognized testing laboratory (i.e. Factory Mutual).

Only the Factory Mutual Research Corporation has a procedure for testing electrostatics. FM refers to their procedure as an approval process. Successful completion of this process results in the product being "listed".

NFPA defines "approved" as "acceptable to the authority having jurisdiction." (i.e. local Fire Marshall, OSHA, etc.). The term "approved" as used by NFPA is not synonymous with the FM approval process. Contact local authorities to ensure the compliance of your equipment.

Are Sprinklers and/or Fire-Detection Equipment Required in a Powder Booth?

Yes, OSHA requires automatic sprinklers inside a booth. NFPA, in addition to many states and cities, requires both automatic sprinklers and flame-detection equipment inside a booth.

OSHA
CFR 1910.107 (h) (12): "Fire Protection. Automatic sprinklers shall protect all areas used for spraying, including the interior of the booth, where this protection is available. Where this protection is not available, other approved automatic extinguishing equipment shall be provided."

NFPA 33 Chapter 7 Protection

7-5 Protection for Automated Powder Application Equipment

Automated powder application equipment shall be protected further by the installation of an approved, supervised flame detection apparatus that shall, in event of ignition, react to the presence of flame within one-half (0.5) second and shall accomplish all of the following:

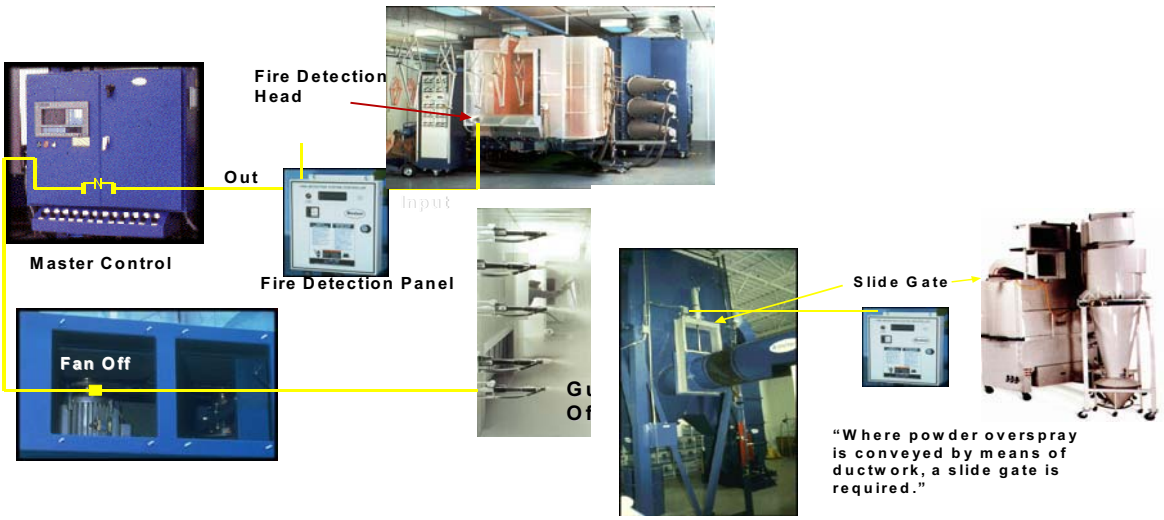
(1) Shut down all energy supplies (electrical and compressed air) to conveyor, ventilation, application, transfer, and
powder collection equipment

(2) Close segregation dampers in associated ductwork to interrupt airflows from application equipment to powder
collectors

(3) Activate an alarm

POWDER COATING SYSTEM VENTILATION SAFETY REQUIREMENTS

Powder Booth Sizing



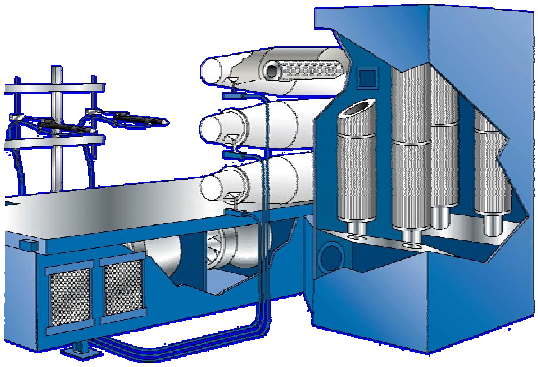
Safety Air Requirements for Powder Booths without Inlet Ductwork

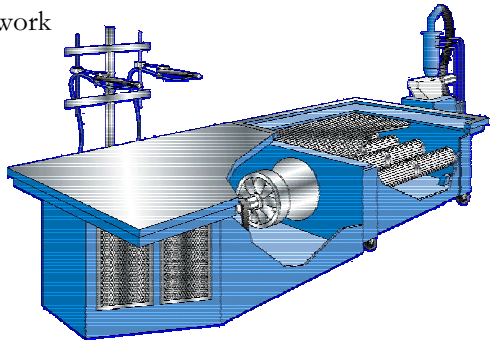
Containment Air Flow Required (CFM) = Total Booth Opening Area (sq.ft.) X Face Velocity (fpm)

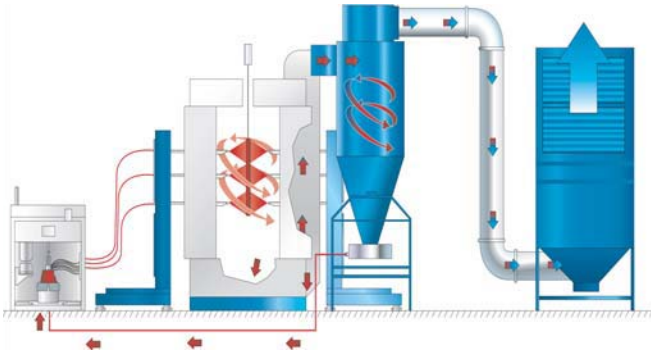
NFPA does not have published minimum air velocity levels for booths; however, they must be strong enough to contain the powder cloud inside the booth. Typically an average face velocity of 100 feet per minute (fpm) is adequate, although some powder booths may require higher air flows, which includes the following:

Tall Booth Openings >6 feet: 120 fpm
Heated Parts >120 degrees Fahrenheit: 150 fpm
Short Part Hooks < 24 inches: 120 fpm
Quick Color Change Booths: 140 fpm

Examples of Cartridge and Cyclone Systems Without Inlet Ductwork







NFPA 33 Chapter 13 Powder Coating

13.7 Ventilation, Dust Collection, and Explosion Protection

13-7.1 Where nondeposited, air-suspended powders (powder overspray) is conveyed by ductwork to a remote recovery system, sufficient airflow shall be provided in the ductwork to maintain the powder concentration in the ductwork at no more than one-half of the minimum explosive concentration (MEC) of the powder in use. If the MEC of the powder has not been established, then the exhaust duct powder concentration shall be maintained below 0.015 oz/ft3.

Safety Air Requirements for Powder Booths with Inlet Ductwork

Safety Air Volume (cfm) = Maximum Gun Output (oz./min ./gun) X (# of Guns)
0.5 (Safety Factor) X LEL (oz./ft3.)

Example of a Safety Air Flow Calculation:

Assuming:

Total number of guns = 41 automatic guns + 4 manual guns

Maximum powder output = 8.5 oz./min. (32 lbs./hr.)

Low explosion limit (LEL) = 0.03 oz./ft3. (typical)

Safety factor = 2

(Maximum output must be verified with supplier)

Then: Safety Air Volume = 8.5 oz./min./gun X 45 guns = 25,500 cfm
(0.5) X 0.03 oz./ft3.

Examples of Powder Booths with Inlet Ductwork



Can explosions occur in powder coating booths?

Yes, closed collection systems such as cyclone booths with inlet ductwork have the potential for explosion. To prevent this occurrence, these types of spray booths require explosion venting to an area outside the plant. Conversely, cartridge spray booths are not closed collections systems; therefore, explosion venting and MEC requirements do not apply.

NFPA 33 Chapter 13 Powder Coating

13.7 Ventilation, Dust Collection, and Explosion Protection

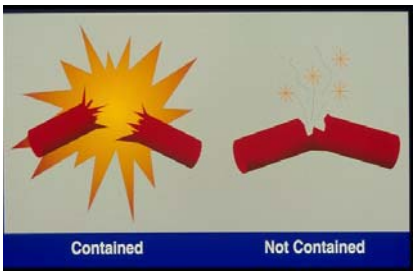
13-7.2 Enclosures either shall be listed for the specific application or shall be designed to resist the destructive effects of an internal deflagration. Any enclosure that is not so listed and is effectively tight, such as a spray booth, dust collector, powder recovery device, or other enclosure, shall be provided with one of the following:

(1) Deflagration Venting
(2) A deflagration suppression system that meets the requirements of NFPA 69, Standard on Explosion Prevention Systems

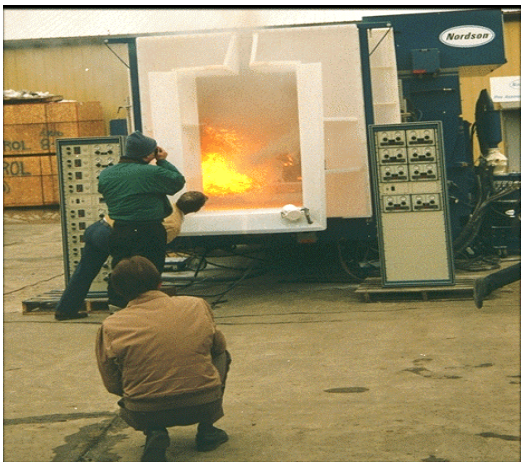
What is a tight enclosure?

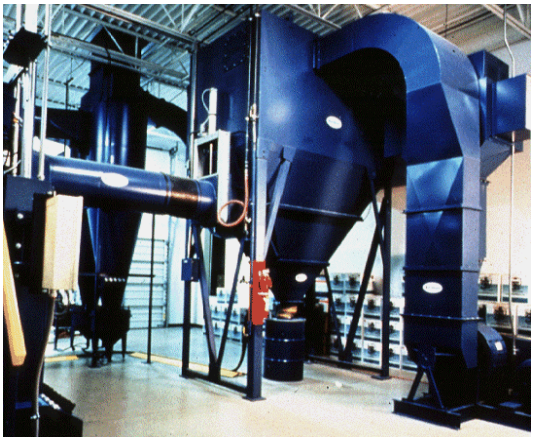
Cartridge Booth Collectors

In a cartridge collection system the large opening area prevents any pressure build-up.

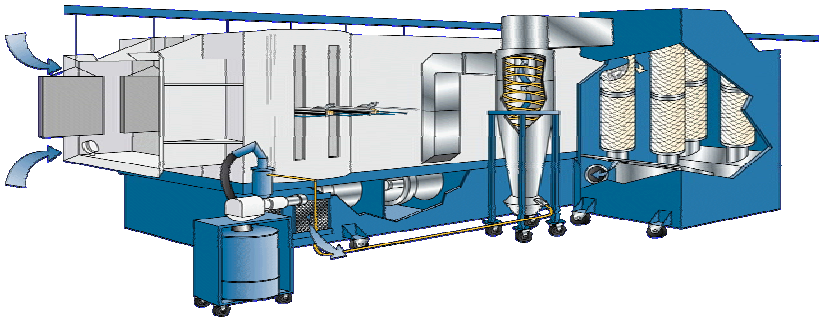


In an integrated spray booth / "open" powder coating will burn, but no explosions have occurred with this type of collections system.





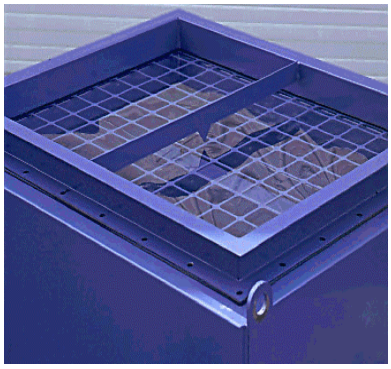
Examples of booths with "tight enclosures"

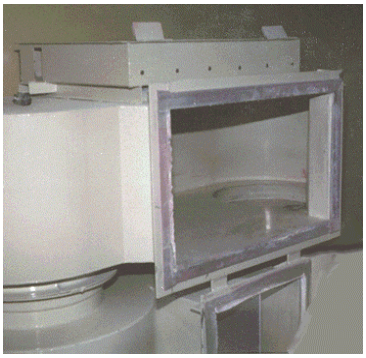


NFPA 68 Chapter 5 Fundamentals of Venting Deflagrations

5.1 Basic Concepts

5.1.1 A deflagration vent is an opening in an enclosure through which material expands and flows, thus relieving
Pressure.



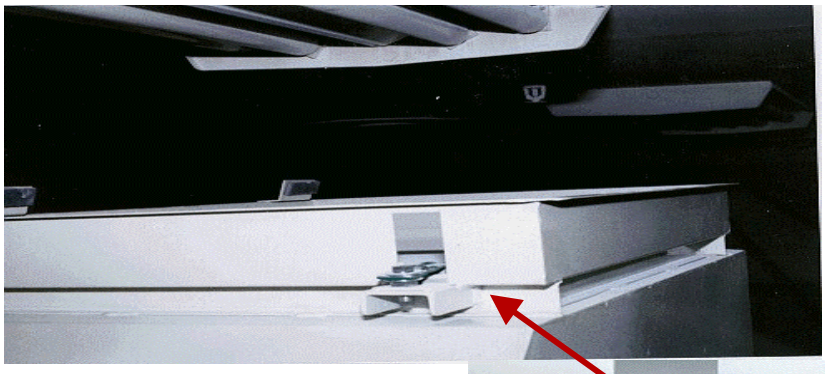


NFPA 69 Chapter 5 Fundamentals of Venting Deflagrations

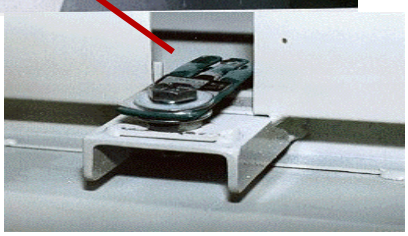
5.2 Consequences of a Deflagration

5.2.1 Damage can result if a deflagration occurs in any enclosure that is too weak to withstand the pressure from a deflagration.

Basic Considerations for Venting



which
opens with time.



5.6.14 For a given vent area, a greater mass per unit
5.6.15 area (higher inertia) of a vent closure results in a higher maximum pressure during venting. Similarly, hinged vent closures can increase the maximum pressure during the venting process by reducing the rate at the available vent area

Deflagration vents with hinged closures are less effective than open vents or vents with lightweight rupture Diaphragms.

5.6 Effects of Vent Discharge Ducts

5.8.1 If it is necessary to locate enclosures with deflagration vents inside building, vent ducts should be used to direct vented material from the enclosure to the outdoors.

5.8.2 Vent ducts should be as short and as straight as possible. Any bends can cause dramatic and unpredictable increases in the pressure that develops during venting.

DEFLAGRATION VENT

5.9 Venting with Flame Arresting and Particulate Retention

5.10.1 There are situations where external venting is not feasible, such as where the location of equipment outdoors or adjacent to exterior walls is impractical, or where ducting is too long to be effective. When faced with this situation, a device that operates on the principles of flame arresting and particulate retention can provide increased workplace safety.

Suppression System

NOTE:

The contents of this publication do not constitute legal advice or opinion. For questions regarding regulatory issues, readers should refer to the appropriate published OSHA, ANSI/NFPA, and Uniform Fire Code (UFC) texts, as well as state and local fire codes.

Mike Streepey is a Powder Systems Specialist with the Nordson Corporation in Dallas, Texas. He holds a Bachelor of Science degree in Marketing from Miami University in Oxford, Ohio, and a MBA from Louisiana State University in Shreveport, Louisiana.