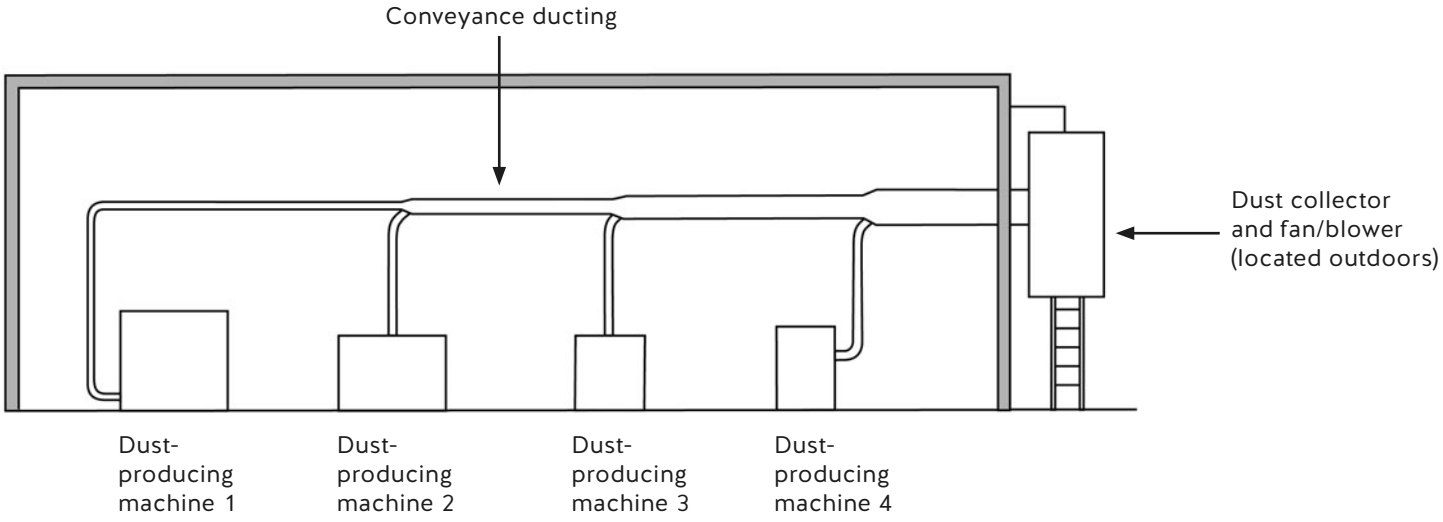
WorkSafe Bulletin

Dust collection systems in manufacturing facilities

Many manufacturing processes produce dust that can lead to fires or explosions in certain conditions. These hazards may exist whether the dust comes from wood, grain, sugar, pharmaceuticals, metals, plastics, rubber, or other materials. One of the best ways to mitigate these hazards is to install an *effective* dust collection system to prevent the accumulation of hazardous dust in the workplace. Be aware that an *improperly* designed, installed, and/or maintained dust collection system can introduce other fire and explosion risks.

A dust collection system can reduce the risks

A properly designed dust collection system will capture dust at the source, help prevent the accumulation of dust, and keep airborne dust at a safe concentration inside a building. It will also minimize the risk of fires or explosions that may occur within the dust collection system. These systems work on the basic formula of capture, convey, and collect. A system may consist of collection hoods (at the dust-producing machinery), conveyance ducting, a dust collector, and an exhaust fan or blower.



This diagram gives an overview of a typical dust collection system at a manufacturing facility.

Dust collection systems can be purchased or designed and constructed for a particular operation or piece of equipment. Equipment suppliers can provide some guidance. However, a professional engineer (P. Eng.) who specializes in dust control systems can ensure that your dust collection system is properly designed for your particular operation to maximize efficiency and safety.

An efficient dust collection system will help ensure that money spent on equipment and power is not wasted. It will also make the workplace safer, cleaner, and healthier, and it can help produce a better product.

Combustible dust fire and explosion hazards

Combustible dust is made up of very fine particles that can ignite and burn when suspended in air. Under some conditions, this may result in an explosion.

Combustible dust fire and explosion hazards may be present in many areas of a facility. But in a 2006 study, the U.S. Chemical Safety Board found that dust collectors were the equipment most often involved in combustible dust incidents. The following section describes one such incident included in the study.

Incident summary: automotive parts factory explosion

A series of aluminum dust explosions occurred at an automotive parts factory. The first explosion occurred in a dust collector, and a fireball spread through the dust collection system. These events dislodged aluminum dust that had escaped from the dust collection system and settled on beams, ledges, and equipment. Some of this now airborne dust ignited and exploded. One worker died, and two others were severely injured. The factory was badly damaged.

An investigation found that accumulated combustible dust played a key role in the explosions. The resulting report identified the following problems (among many others):

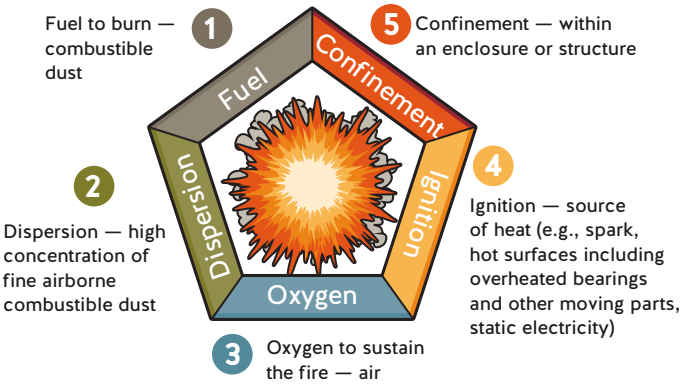
- The dust collection system was inadequately designed and installed.
- Housekeeping and maintenance were inadequate.
- Workers had received no formal training for operating and maintaining the dust collection system and other key equipment.

Dust collection systems present risks that must be managed

By their very nature and design, dust collection systems contain four of the five dust explosion pentagon elements. The only element missing is an ignition source.

To reduce the risk of fires and explosions, dust collection systems must be designed according to good engineering practice. For example, the system must be made of non-combustible materials, and sparks must be prevented or suppressed. Dust collection systems must also be properly installed and maintained, and workers must be trained to use them correctly. Regularly scheduled, proper housekeeping is also crucial.

Dust explosion pentagon



How dust collection systems work

First, the dust must be captured. Dust capture is typically the weakest point in the system if it is not properly designed. Devices such as collection hoods catch dust where it is produced. The dust-producing machine may have a built-in hood along with a port to which a duct can be directly attached. If not, a specialized hood may need to be designed and installed to effectively capture the dust at the point where it is produced.

Second, the dust must be conveyed pneumatically to the dust collector through a ducting system. The ducting system must be properly designed and built and of adequate size to maintain a consistent minimum air velocity. This ensures that the dust remains suspended in air within the duct all the way to the collection device. If a duct is the wrong size, dust may settle in the ducting system and clog it, increasing the risk of combustion.

Finally, the dust is collected in a variety of ways, depending on the application and the type of dust being handled. The four major types of dust collectors for particulate contaminants are electrostatic precipitators, fabric collectors (e.g., baghouses), wet collectors, and dry centrifugal collectors (e.g., cyclones). Some collectors can present fire or explosion risks because they concentrate fine dusts in a confined environment. You need to control these risks through proper design, installation, and maintenance.

Properly designed dust collection systems may require:

- Spark- or explosion-suppression systems
- Abort gates
- Backflow preventers
- Rotary valves
- Blast gates
- Inspection ports
- Grounding and bonding

Installation and maintenance

- Follow the manufacturer's instructions and applicable standards and codes when installing and maintaining a dust collection system.
- Install dust collectors outdoors whenever possible.
- Direct explosion venting outside and away from areas where workers or the public have access. To reduce potential damage from fires and explosions, perform a risk assessment to evaluate the location of the dust collection system and its fire and explosion controls.
- Minimize the escape of dust by installing collection hoods as close to dust-producing processes as safely possible, or by enclosing these processes.
- Position each collection hood so that the ejected dust is directed toward the hood (for example, on the bottom of a saw blade designed to cut on the down stroke).
- Maximize the velocity in your dust collection system by choosing ducting that minimizes airflow resistance.
- Minimize the length of ducting used, and avoid sharp bends or connections.
- Use appropriate electrical and ventilation equipment.
- Put covers around pipes and cables, or embed them in the walls where possible. This helps reduce the surface area where dust can accumulate.
- Keep all mechanical and electrical equipment in good condition.
- Keep static electricity under control. This includes the bonding and grounding of equipment. Check all bonded and grounded equipment regularly to ensure the bonds are in good condition.
- Check equipment that may wear out (for example, bearings). Control mechanical sparks and friction. Friction and fast-moving equipment may generate heat and become ignition sources.

- Remove open flames, sparks, friction, heat sources, and other potential ignition sources in and around the dust collection system.
- Select and use intrinsically safe tools and machinery.

Inspections

To keep your dust collection system operating efficiently, establish a preventive maintenance schedule that includes regular inspections, cleaning, and servicing.

- Follow the manufacturer's instructions on how to inspect your dust collection system and its components.
- Look for the following evidence of poor maintenance, bad practice, and ineffective collection and transport:
  - Misting at the collection hood that could plug the system
  - Dust accumulations near collection hoods and machinery
  - Significant leakage or escape of dust from the system back into the facility
  - Ducts or hoods made out of plastic or combustible material
  - Dust hoods that impede airflow
  - Poor duct design (for example, sharp turns, or sudden changes in duct diameter)
  - Clogged ducting
  - Damaged ductwork
  - Additions, modifications, or increased loading to the system (for example, a dust collector too small for the number of machines connected to it)
- Look for potential ignition sources and failed ignition source controls (for example, damaged bonding connections).
- If the system is equipped with baghouse fabric collectors or closed-top cyclones, ensure that:
  - Properly designed inlet backflow prevention devices are installed.
  - Safe blast zones are identified on all discharge outlets.
  - All safety devices (abort gates, sensors, sprinklers, spark detectors, etc.) installed in the system are tested periodically.

Common dust collection system pitfalls

- Inadequate design around ducting junction points, including the location of inspection points
- Inadequate design of dust collection hoods
- Insufficient transport velocity in the system (i.e., an under-designed system), resulting in captured dust settling inside ductwork
- Non-engineered modifications to ventilation systems following the initial design and installation
- Failure to replace or repair damaged parts
- A poor or inadequate maintenance program
- Inadequate design and installation of the dust collector

Training

Where applicable, train workers in the established operating and safe work procedures for your dust collection system. Provide both initial training and refreshers.

Housekeeping

Provide continuous housekeeping and cleaning for the dust collection system and surrounding areas using procedures (such as vacuum cleaning) that minimize dust-cloud generation. Housekeeping should occur at a frequency that minimizes dust accumulations in your workplace. Portable vacuum cleaners must meet *Canadian Electrical Code* Class II hazardous location requirements when operated in a combustible dust hazard area.

For more information

For more information, visit the combustible dust resources web page for manufacturing.
www2.worksafebc.com/Portals/Manufacturing/InjuryPreventionResources.asp?ReportID=37460