Combustible Wood Dust Management Program Development Guide

Introduction

Combustible wood dusts in the work place present a risk of both fire and explosion if they are not managed effectively. A dust explosion or serious fire can cause catastrophic loss of life, injuries, and destruction of buildings.

WorkSafeBC requirements contained in *Prevention Policy Item D3-115-3 Employer Duties-Wood Dust Mitigation and Control,* identify reasonable steps for an employer to take to address the hazards of combustible wood dust. Controlling combustible wood dust hazards requires a systematic long term approach contained in a program. This document is intended to provide guidance on developing and implementing such a program.

Employers should be aware that there are legislative requirements administered by agencies other than WorkSafeBC that may have similar or overlapping requirements relating to combustible dust risks and controls. Examples include the *BC Fire Code,* the *Safety Standards Act* (electrical and gas installations), and *BC Building Code.* Employers are encouraged to consult with the individual agencies on these requirements.

Program elements

A combustible wood dust management program (the "Program") should include the following elements:

1. **Policy statement** to define the overall aims, objectives, and responsibilities.

2. **Risk assessment process** to identify and evaluate combustible wood dust hazards and the impact of changing conditions.

3. **Implementation of controls** to effectively minimize combustible wood dust risks.

4. **Inspections** to ensure combustible dust risks are being effectively managed

5. **Investigation** of fire incidents, reports of unsafe conditions, and work refusals to prevent the reoccurrence of similar or more serious incidents.

6. **Education, training, and supervision** to ensure workers understand the hazards associated with combustible dust and the measures to control the hazards, and to ensure they work in accordance with applicable rules and procedures.

7. **Program audit and review process** to ensure the Program has been fully implemented and is effective.

8. A **corrective action management process** to ensure that recommendations and remedial action identified through the Program activities are effectively implemented.

9. **Records and statistics** to facilitate internal and external reporting, track program activities and changes, and identify trends.

An employer's combustible wood dust management program should be in writing and may be included as part of a facility's existing safety management system and maintenance program or developed as a standalone program.

These Program elements will function best within a "Plan-Do-Check-Act" approach, which is commonly used in a number of safety management system standards such as CSA Z1000-06 Occupational Health and Safety Management. This approach provides a framework that is well suited to managing combustible dust risks. Because the risks associated with combustible dust fires and explosions are impacted by numerous factors and cannot be completely eliminated in a wood product manufacturing environment, employers must actively manage and continually monitor their control efforts, and make changes as necessary to continually improve safety.

Policy statement of overall aims, objectives, and responsibilities

As part of the Program, an overall statement of aims and objectives should be developed, and roles and responsibilities of all parties should be clearly defined. This is to ensure that the Program is fully implemented, and all workplace parties apply and comply with the requirements of the Program.

Roles and responsibilities

Roles and responsibilities should be clearly defined in applicable key areas of combustible dust management. These key areas of responsibility may include:

- Orientation and training of employees
- Hazard assessment
- Implementation of dust mitigation systems and controls
- Housekeeping
- Inspections, measurement, and monitoring of combustible wood dust accumulations
- Electrical and mechanical preventative maintenance programs
- Tracking and completion of corrective actions
- Emergency preparedness and response plan
- Wood dust mitigation and control audit
- Annual Program review
- Record keeping and statistics

Qualified personnel

Personnel assigned to individual areas of responsibility must be qualified to manage those areas based on their training, education, and experience, or any combination of these three criteria.
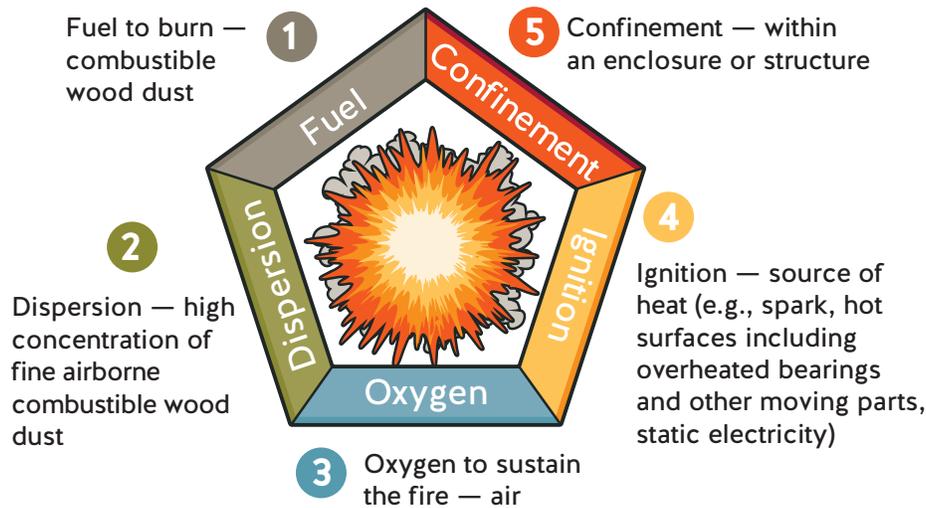
Risk assessment process

The first step in a comprehensive risk assessment is to identify where combustible wood dust hazards may exist. The entire facility must be inspected to identify areas where combustible dust is produced and can accumulate. The assessment process must be conducted in a manner that gives due consideration to the potential for fire and explosion, and the applicable risk factors that relate to each hazard. The purpose of the assessment is to categorize and prioritize combustible wood dust risks to ensure hazard mitigation, control efforts, and resource allocation are effective.

The risk assessment must cover the following:

- All buildings and structures on the site
- Concealed spaces such as attics, false ceilings, crawl spaces, etc.
- Elevated horizontal surfaces
- Basement areas
- Fully or partially contained, enclosed, or compartmentalized areas
- Mechanical and electrical equipment and their enclosures
- Outside areas adjacent to buildings and structures
- Processes that use, consume, produce, or handle combustible dusts
- Work activities that may introduce or increase combustible dust risks

The risk assessment must consider the following elements of the dust explosion pentagon, along with the effectiveness of existing controls.

Fuel to burn — combustible wood dust **1**

5 Confinement — within an enclosure or structure

2 Dispersion — high concentration of fine airborne combustible wood dust

4 Ignition — source of heat (e.g., spark, hot surfaces including overheated bearings and other moving parts, static electricity)

3 Oxygen to sustain the fire — air

1. Wood dust as a fuel

To determine the extent and nature of the risk presented by an existing dust accumulation, the employer must evaluate the characteristics of the dust. The critical properties that determine whether or not the dust is a fire, deflagration or explosion hazard are the particle size and moisture content. Based on its characteristics, dust can be classified as either "primary" or "secondary".

"Primary" dusts are those found on floors and surfaces near or below the dust producing or waste handling equipment. Primary dusts consist generally of greener, moister and coarser particulate and can present a fire hazard if not actively managed. Unmanaged primary dusts will, over time, dry out and spread over a broad area and present a fire hazard and will also release finer, drier secondary dusts that are often the fuel source for serious fires and explosions. Primary dust accumulations also present a fire hazard when they are in direct contact with equipment that produces heat or that might be a potential ignition source.

"Secondary" dusts are the finer, drier dusts that are broadly dispersed and that settle away from the points from which they are produced or released. "Secondary" dusts are to be considered deflagrable unless the employer has conducted appropriate and representative testing to show otherwise. Where deflagrable secondary dusts are present at a depth of 1/8" or more over 5% of a given work area, they present a fire or explosion hazard

All wood dust should be assumed to be combustible unless the employer can demonstrate otherwise. In many cases this will require appropriate and representative testing to be conducted.

Testing of dust properties can determine the explosivity and subsequent hazard of the dust produced by the facility, and may be required to ensure proper design and engineering of ventilation systems which handle combustible dust. Employers who undertake testing of wood dust must ensure that recognized methods are used and that the persons collecting the samples and conducting the analysis are qualified to do so. For combustible dust sampling and analysis, WorkSafeBC recommends following the OSHA ID-201SG sampling method guideline.

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The OSHA Combustible Dust Emphasis Program (CPL 03-00-008) also provides information on sample collection.

The rate of dust accumulation and the potential for upset conditions should also be considered in the assessment. This is important to ensure appropriate intervals for clean-up and inspections are established for a given area.

2. **Ignition potential**

   In areas where dust may accumulate, the potential for that dust to ignite must be considered.

   Potential ignition sources include but are not limited to:

   - Hot work
   - Hot surfaces
   - Open flame or fuel-fired heating equipment
   - Friction points (including bearings, drives, and gear reducers)
   - Machine and processing equipment
   - Electrical systems (including facility lighting)
   - Static electricity
   - Smoking
   - Lightning
   - Tramp metal/foreign material

   Employers are encouraged to further evaluate the ignition potential of these activities, equipment and events based on available information, including manufacturer's specifications. After identifying and evaluating ignition potential, employers should:

   1. consider controls aimed at protecting or isolating ignition sources from dust;
   2. ensure equipment is properly maintained; and,
   3. identify priorities for cleaning and inspection.

3. **The degree of containment**

   The explosion potential of all work areas which are fully or partially enclosed, contained, or compartmentalized should be evaluated separately.

   Examples of fully or partially enclosed, contained or compartmentalized areas that are commonly found in wood product manufacturing facilities may include but are not limited to:

   - Planer enclosures
   - Conveyor tunnels or galleries
   - Chipper and blower rooms
   - Basement areas between enclosed waste conveyance lines
   - Log in-feed, cut-off, and de-barker areas

4. **Dispersion in air**

   Identify mechanisms or locations that may disperse fine, dry dust into the air in high concentrations. Examples of this may include but are not limited to:

   - Discharge from saws or other dust handling equipment
   - Equipment vibration
   - Conveyor transfer points
   - Compressed air use
   - Upset conditions

   Identify areas with a secondary deflagration potential such as areas where adjacent dust may be dispersed by an initial event and create conditions for rapid fire or explosion propagation.

5. **Identification of existing controls**

   List existing controls in each area and evaluate the effectiveness of these measures.
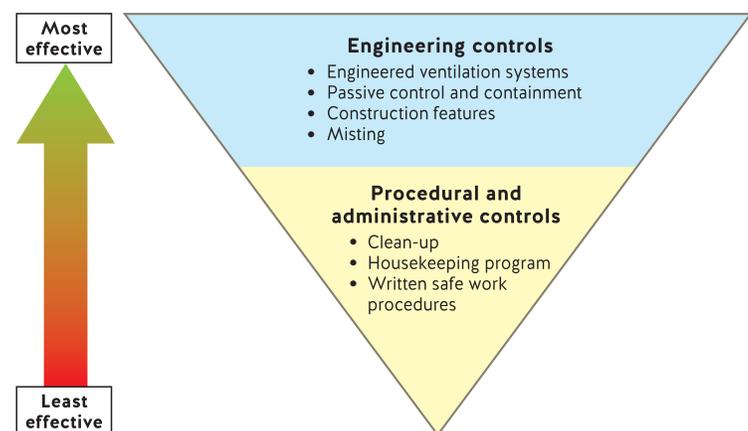
Implementation of controls

The risks associated with combustible dust cannot be eliminated completely. A broad range of controls are necessary to ensure sustainable and effective control of combustible dust-related hazards.

Employers should consider applying a hazard control hierarchy. Controls that are designed to control dust at the source, or keep dust from escaping or spreading, are generally more reliable and effective than administrative or procedural controls, which rely on people to perform work or follow procedures to control risks.

The hierarchy of hazard controls may include, but is not limited to:

- Ventilation and dust collection systems
- Passive control and containment
- Facility construction features
- Misting
- Clean-up and housekeeping program
- Written safe work procedures to guide and direct workers to safely perform tasks that may introduce combustible dust risks

Hierarchy of Hazard Controls for Combustible Dust

Most effective

Engineering controls
- Engineered ventilation systems
- Passive control and containment
- Construction features
- Misting

Procedural and administrative controls
- Clean-up
- Housekeeping program
- Written safe work procedures

Least effective

Any dust management program will use a combination of these controls. However, employers should focus on implementing controls that are as high up the control hierarchy as possible to minimize the dependence on less reliable control measures. That is, ventilation and passive controls should be preferred over housekeeping and safe work procedures.

Control: Ventilation and dust collection systems

Ventilation and dust collection systems are key elements in reducing or eliminating the dust hazard within a building. By controlling dust at the source, the need to manage the "downstream" dust can be greatly reduced. However, ventilation and dust collection systems can bring together all the dust explosion pentagon elements. Specific fire or explosion prevention and mitigation measures may be required for certain applications.

Dust collection systems should be engineered, designed, installed, and maintained in accordance with recognized standards, such as those published by the National Fire Protection Association (NFPA) or in the American Conference of Governmental Industrial Hygienists (ACGIH) Industrial Ventilation Manual.

Control: Passive control and containment

Machinery and equipment used to cut, shape, pulverize, chip, or transfer wood fibre has the ability to generate large quantities of dust throughout the process. Passive controls and containment options are solutions generally intended to:

- Keep wood dust and debris within the appropriate conveyance and handling systems.
- Limit or control the spread and release of dust, both in the area it is produced and in the downstream processes where further handling and processing of the dust, debris, or the product itself may release more dust.

Many of these opportunities can be identified through a proper assessment and can be implemented in-house. Examples include but are not limited to:

- Improving chuting and drop-outs to conveyors to collect debris, particles, or combustible dust on or beside the machine centre.
- Designing drop-outs, grizzlies, etc., to adequately capture debris at the machine centre and reduce carryover that may be forwarded on belts or the boards after the machine centre.
- Shielding the machine centre to contain dust and debris so that it falls into the appropriate system.
- Diverting dust away from potential ignition sources such as high-speed bearings and electrical motors.
- Installing belt scrapers or cleaners to prevent dust that adheres to conveyor belts from re-entering the mill.
- Choosing solid flooring rather than grating in areas downstream from machine centres that tend to carry sawdust on boards. This prevents material from depositing onto hard to access surfaces such as cable trays, beams, pipes or heaters.

Control: Construction features

The use of proper construction features is crucial to preventing and mitigating loss from fire and explosion in wood handling facilities where a combustible dust hazard exists. Use of proper materials and construction features can also reduce dust and debris accumulations, simplify and complement good housekeeping practices, and limit the spread and damage should an event occur.

Where a combustible dust hazard exists, new buildings should be constructed in accordance with applicable codes and standards.

Employers should make improvements to interior surfaces to reduce the areas where dust can accumulate, and facilitate cleaning in existing facilities. Examples of these improvements include:

- Removing obsolete equipment
- Covering walls and ceilings with smooth materials to eliminate horizontal surfaces and prevent dust adherence
- Boxing-in structural steel that has horizontal surfaces such as I-beams or U-shaped channels
- Installing sharply sloped (45-60 degrees) covers or caps on windows, ledges, girders, beams and other horizontal surfaces, including electrical equipment, to minimize dust deposit
- When enclosing an area, fully seal the cavity to prevent wood dust from entering

Control: Misting

Water misting systems can be effectively used to help with dust control, but should not be used as a substitute for good housekeeping practices. Misting systems can limit the spread of finer dust, and can also reduce the amount of dust that settles in elevated and difficult to access locations.

Water misting systems can be utilized inside or above machine centres where dust is produced by saws, knives, or other cutting/shaping or pulverizing devices.

Stand-alone, blower-type misting systems are also available. These systems can cover wide areas of the facility such as above debarkers or canter machines.

When considering water misting systems, the area should be analyzed to ensure the system will not prevent dust from being conveyed or collected. Misting systems can significantly impair the proper and safe operation of ventilation systems. Placing misting systems in proximity to dust collection hoods requires careful consideration to ensure it does not negatively impact the ventilation system and create additional hazards.

Control: Clean-up and housekeeping

The employer must ensure that clean-up and housekeeping activities are performed on a regular basis to ensure that both primary and secondary wood dusts are actively managed.

The clean-up and housekeeping procedures should include:

- Defined cleaning frequencies based on the risk assessment. These frequencies need to be adjusted as necessary.

- Clear identification of what areas to be cleaned, such as horizontal surfaces, floors, equipment, ducts, hidden or enclosed areas, or areas around potential ignition sources.
- Control of ignition sources prior to cleaning activities.

Other clean-up and housekeeping considerations include the following:

- Methods of cleaning must not create a dust cloud during clean-up activities.
  - Preferred methods are sweeping, vacuuming or water-wash down.
  - The use of compressed air for clean-up purposes should be discouraged and minimized as it can cause the dust to be suspended in air and increase the likelihood of an explosion if an ignition source is present. If compressed air use is required, safe work procedures must be developed and implemented.
- Many areas where clean-up work is performed may expose workers to other safety hazards. Lockout, safeguarding, and fall protection are examples of requirements that may need to be addressed in the clean-up procedures.
- Spaces which are difficult to access should be sealed to prevent dust from accumulating in these areas.
- To facilitate clean-up, parts and materials should not be stored in dust-producing areas.

Control: Safe work procedures

Written instruction and safe work procedures to guide and direct workers in how to safely perform their duties may be required in several areas including but not limited to:

- Compressed air use
- Clean-up procedures
- Hot work procedures
- Emergency response procedures
- De-energization during clean-up activities

Inspections

A robust inspection system requires that regular inspections of premises, equipment, and work practices are conducted at appropriate intervals that will prevent the development of hazardous combustible dust conditions. This is essential for maintaining an effective Program.

Inspections must address fuel accumulations, equipment that could become a potential ignition source, and control measures.

Inspections: Clean-up and housekeeping

Clean-up and housekeeping inspection frequencies should be identified for each area of the facility based on the risk assessment, and adjusted as required to ensure dust accumulations do not exceed limits.

The inspection system should:

- Inspect all areas of the facility.
- Identify how much dust has accumulated and how quickly it accumulates.
- Identify dust accumulations in relation to potential ignition points.
- Assess the adequacy of clean-up efforts.
- Evaluate adherence to safe work procedures.

Inspections: Equipment inspection and preventative maintenance

Inspecting equipment that can act as potential ignition sources is intended to ensure such equipment is properly functioning and maintained so as to minimize the ignition potential associated with it. Equipment that is run to failure may become an ignition source and can be the cause of a catastrophic event.

Persons performing these types of inspections require additional qualifications. These inspections are typically performed by qualified tradespersons.

The following general considerations apply to the inspection and preventative maintenance of equipment:

- Inspections should be scheduled based on the risk assessment, the findings from previous inspections, and applicable manufacturer's instructions.
- Frequencies should be adjusted as required.
- A method should be in place to record and track items requiring repair, as well as items that have been repaired.

Electrical system preventative maintenance

A schedule should be in place for inspections and cleaning of electrical room enclosures, electrical equipment, and cabinets. These should be inspected and cleaned to ensure:

- They are intact and properly sealed; and,
- Dust is not accumulating within the enclosure.

Inspections must be done by qualified persons. The BC Safety Authority has jurisdiction over electrical equipment and should be consulted as necessary.

Mechanical systems preventative maintenance

Preventative maintenance inspections of mechanical systems should focus on friction-producing equipment such as gear reducers, bearings, conveyor spools, and belt drives.

Ventilation system preventative maintenance

Preventative maintenance inspections of ventilation systems should include:

- Inspection for damage that may negatively impact collection or transport of dust;
- Inspection for build-up of dust or plugging in the duct work; and,
- Inspection and maintenance of fire protection or explosion mitigation devices or features.

Investigations

All fire incidents should be treated as near-miss incidents and investigated to identify measures to prevent the reoccurrence of similar or more serious incidents. Other agencies may have specific requirements for reporting and investigating fire-related incidents. It is the employer's responsibility to identify these requirements.

Training and orientation

Employers must provide workers and supervisors with training on combustible wood dust hazards and the measures to control these hazards. Workers and supervisors should be made aware of all known or reasonably foreseeable hazards to which they are likely to be exposed, and of their rights and responsibilities under the *Workers Compensation Act* and the *Occupational Health and Safety Regulation.*

Employers must educate and train workers and supervisors about the hazards and measures in the Program. The education and training program should include information on:

- Characteristics of combustible dust
- Identification of combustible dust hazards
- Methods of control for combustible dust
- Identification and control of ignition sources
- Fire-fighting controls
- Emergency response procedures
- Safe work procedures (e.g., compressed air use, clean-up procedures, hot work)
- Reporting of combustible dust hazards, and
- The right to refuse unsafe work

Audit and regular review

The Program should contain provisions for both auditing and regular review of the Program. The purpose of the audit and regular review is to ensure that all elements of the Program have been effectively implemented and are functioning as intended. These processes also serve as a mechanism to identify changes, trends, and opportunities for continual improvement.

Contractors should also be educated and trained on the hazards of combustible dust and any applicable procedures relating to combustible dust control.

Audit

The employer must ensure that a wood dust mitigation and control audit is completed for each operating location as soon as reasonably possible after implementing the Program. After this audit, the facility must:

- Promptly implement recommendations from the audit; and,
- Conduct a new audit if there is any material change to work processes or equipment.

Auditors must be qualified to perform the audit. They should have a combination of experience, training and qualifications that indicate that they are knowledgeable of the hazards and mitigation controls related to combustible dust. Suggested qualifications include:

- Industry knowledge and work experience in the applicable type of wood product manufacturing facility
- Demonstrated understanding and knowledge of applicable codes, standards and guidelines
- Education and professional designations

The employer should also:

- Use defined standards and protocols
- Correct any non-conformance items identified in a timely manner
- Communicate results of all audits to management and employees

Program review

The annual Program review should include:

- A review of the previous audit results and confirmation that action items from the audit were completed or are in progress;
- Consideration of any new regulations or guidelines related to combustible wood dust accumulation, management, mitigation, and control; and,
- Consideration of actual or anticipated changes to the facility or process to ensure any material changes to work processes or equipment are addressed by, and comply with, the Program.

In addition to an annual review, regularly scheduled meetings must be conducted to:

- Review the program activities;
- Identify inspectional or incident trends;

- Identify and make improvements to the program, including consideration of additional control options and updating of policy and procedures; and,
- Identify and address material changes to work processes or equipment.

Corrective action management process

Effective combustible dust management and control requires an iterative approach in most workplaces and requires close monitoring of Program activities. Recommendations and corrective actions should be generated from the program activities and implemented in a timely manner.

A corrective action management process includes a method for tracking and logging completion of the action items identified during risk assessments, internal tours, inspections, investigations, audits, and Program reviews.

The corrective action management process should be integrated with all elements of the Program and include the following considerations:

- Clear identification of action items or action plans
- Assigned responsibility for completion
- Target date for completion or implementation
- Provision for monitoring implementation
- Provision to evaluate the effectiveness of the changes

Records and statistics

For the purpose of demonstrating due diligence and effectively managing combustible dust hazards, relevant records and statistics should be maintained. These may include, but are not limited to, the following reports and documentation which are produced as part of the Program:

- Risk assessment results
- Control documents, such as engineering designs and manufacturer's instructions
- Inspection documents
- Incident investigation reports
- Records of orientation, training, and supervision
- Sampling results (if applicable)
- Audit reports
- Corrective actions
- Trend analyses which is suggestive of unsafe conditions, acts, or work procedures

Conclusion

The program elements set out above provide a framework for managing combustible wood dust hazards. The effectiveness of any combustible wood dust management program will rely on sustained attention and diligence, as well as constant evaluation and adjustment to adapt to changing circumstances.

It falls to each employer to actively manage and continually monitor control efforts within the context of that employer's specific workplace.