Australian Forest Products Association

MANAGING DUST AND FIRE EXPLOSION RISK

ACKNOWLEDGEMENTS

This project was initiated and managed by the Australian Forest Products Association (AFPA) Softwood Manufacturing Ch amber, Workplace Health and Safety Sub Committee. AFPA thanks the numerous industry participants who volunteered their assistance in the development of this guide.

DISCLAIMER

This Guide is not intended to be a procedural document or a work standard. The information contained within is provided to raise awareness of the fire and explosion risk in hazardous dust areas and provide practical information to assist in managing the associated risk.
The information should not be construed in any way as providing legal advice or deemed to represent a policy position.

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1.0 INTRODUCTION

The Australian Forest Products Association (AFPA) has developed this guidance document regarding the dust fire and explosion risk inherent in timber manufacturing to assist businesses with safe operation.

2.0 SCOPE

This Guide is designed to enable anyone in the timber industry operating a manufacturing site to readily identify and manage wood dust fire and explosion risk.

Potential for fire and explosion in timber manufacturing operations is a broad subject. Therefore, this Guide is limited to the fire and explosion risk associated specifically with wood dust.

The Guide does not address general dust suppression, e.g. managing environmental or health hazards. Rather, this Guide deals exclusively with managing fire and explosion risk related to dust created during the manufacturing process.

This Guide does reference stockpile management, only in the context that it is an important factor in managing fuel load and ignition control in hazardous dust areas.

3.0 OBLIGATIONS

Persons conducting a business or undertaking (PCBUs) / Employers must meet their duties and obligations under relevant health and safety laws.

A PCBU / Employer must prevent the possibility of fire or explosion from an ignition of flammable substances associated with a hazardous area or a hazardous atmosphere.

Electrical safety and work health and safety legislation imposes a primary duty of care on a PCBU / Employer to ensure that hazardous areas are identified and classified. Where a PBCU / Employer identifies the potential for a hazardous area, a competent person should be engaged to assess and classify the area.

A PCBU / Employer must consult with workers when:

- identifying hazards and assessing risks to health and safety arising from the work conducted or to be carried out
- making decisions about ways to eliminate or minimise those risks

4.0 RISK MANAGEMENT APPROACH

While fire is an obvious hazard in wood processing plants, a less obvious hazard is a dust explosion. Sawdust created throughout the milling process, is not explosive on its own, but under the right conditions wood dust can cause flash fires that, if contained within a full or partial enclosure, can produce an explosion due to the pressure build up.

Fire and explosion can result in catastrophic consequences, causing significant injury or death to workers and others, as well as considerable damage to property and loss of ability to operate.

4.1 UNDERSTANDING THE HAZARD

- Fire: the fire triangle (figure 1) is composed of the three components necessary to successfully produce flame - heat, fuel, and oxygen. Without the existence of any of one of these three elements, fires are not able to be ignited or sustained. Under the right conditions wood dust can cause flash fires


DUST
MASKS
DUST MASKS

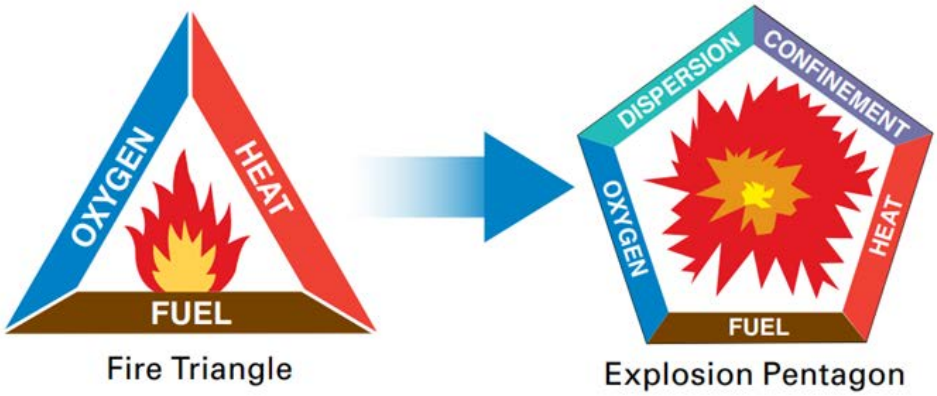
Explosion: Explosions can be either deflagration (slower explosion, less severe) or detonation (rapid explosion, very severe).

- Deflagration is slower than the speed of sound, usually confined and involves low explosives
- Detonation is faster than the speed of sound, not typically confined, involves high explosives and is louder

Explosions, deflagrations and detonations explained

A common occurrence is for a small initial explosion to occur within a localised piece of equipment, this minor shock can then be strong enough to shake the building and release a great deal more dust into air suspension. This additional dust now in suspension can create the conditions for a large secondary explosion involving the entire building.

Figure 1. Fire triangle and explosion pentagon -removal of at least one of the contributing factors will prevent a dust fire or explosion.



There are two conditions which are significant in the potential for ignition of a fire and the energy output of a dust explosion. These are dust particle size and dust moisture content. In both cases, less is more, i.e. the smaller the particle size, the less the amount of energy required to ignite it, and the more explosive the force will be generated if ignited. The same is true for moisture content - dust with less moisture content is more susceptible to ignition and generates higher explosive forces. So higher risk areas in most plants are at the planer mill building including storage and extraction systems and associated equipment where kiln dried timber and sawdust is produced or processed.

4.2 FACILITY HAZARD IDENTIFICATION AND RISK ASSESSMENT

To determine whether a hazardous area potentially exists identify the following:

- Presence of materials that can be combustible when finely divided e.g. sawdust
- Processes which use, consume, or produce combustible dusts
- Open areas where combustible dusts may build up
- Hidden areas where combustible dusts may accumulate
- Means by which dust may be dispersed in the air
- Potential ignition sources

The most accurate way to determine potential for explosion of sawdust product is through qualified third-party testing. The two parts to an accurate classification are qualified hazardous area person to classify the areas and third-party testing of the sawdust product (i.e. Simtars).

Hazardous area classification

The purpose of a hazardous area classification (HAC) is to reduce the chance of an explosive/flammable atmosphere contacting an ignition source by facilitating the proper selection and installation of equipment to be used safely in that environment.

This is achieved by:

- assessing the risk of fire and explosion hazards in and around installations
- establishing zones where explosive atmospheres are expected to exist and determining the size and ignition characteristics of the atmospheres
- categorising the minimum level of ignition source protection required for equipment to be installed or taken within a hazardous area to control the risk of a fire or explosion

AS/NZS 60079.10.2 Explosive atmospheres Classification of areas - Explosive dust atmospheres is the relevant standard for classifying hazardous areas and defines three zones where explosive dust atmospheres may exist (defined as Zones 20, 21 and 22). These zones can be described as follows:

- **Zone 20** – a place in which an explosive dust atmosphere, in the form of a cloud of dust in air, is present continuously, or for extended periods or frequently. The dust will be in sufficient quantity to be capable of producing an explosive concentration of combustible dust mixed with air, and/or where layers of dust of uncontrollable and excessive thickness can be formed. Typical examples of include hoppers, silos, cyclones and filters, dust transport systems, blenders, relevant ductwork to and from baghouses, mills – usually inside apparatus
- **Zone 21** – a place in which an explosive dust atmosphere, in the form of a cloud of dust in air, is likely to occur in normal operation occasionally. The dust will be in sufficient quantities to be capable of producing an explosive concentration of combustible dust mixed with air. Examples include areas in the immediate vicinity of access doors, feed belts, sampling points, and areas where dust accumulation is like to be disturbed
- **Zone 22** – an area in which an explosive dust atmosphere, in the form of a cloud of combustible dust in air, is not likely to occur in normal operation but, if it does occur, will persist for a brief period only. This may also occur when accumulations or layers of combustible dust may be present under abnormal conditions and give rise to combustible mixtures of dust in air. Examples include, malfunctioning or damaged equipment, locations near equipment that is opened at infrequent intervals, and storage of bags containing dusty products

The HAC should be conducted by those who are competent and understand the relevance and significance of the characteristics of dust and those who are familiar with the process and equipment, along with safety, electrical, mechanical, and other qualified engineering personnel.

HIERACHY OF CONTROLS

HIGHEST

MOST

LEVEL 1

Eliminate the hazards

LEVEL 2

Substitute the hazard with something safer.

Isolate the hazzard from people.

Reduce the risks through engineering controls.

LEVEL 3

Reduce exposure to the hazard using administrative actions.

Use personal protective equipment.

Level of health and saftey protection

Reliability of control measures

LOWEST

LEAST

HACs are a living document. They should be referred to during new installations, site inductions, change assessments and inspections, and maintenance and repair activities. They also require periodic review.

4.3 CONTROLLING THE RISKS

The ways of controlling risks are ranked from the highest level of protection and reliability to the lowest as shown in the Hierarchy of Control measures illustrated in figure 2. The hierarchy of control measures can be applied in relation to any risk. The WHS Regulations make it mandatory for duty holders to work through this hierarchy when managing certain risks.

Figure 2 - Hierarchy of Control (left side of page)

Always aim to eliminate the risk, which is the most effective control. If this is not reasonably practicable, you must minimise the risk by working through the other alternatives in the hierarchy.

The lower levels in the hierarchy are less effective because controls that change the hazard or minimise exposure to the hazard can only minimise the risk. You cannot eliminate the risk without eliminating the hazard.

Administrative controls and personal protective equipment (PPE) are the least effective at minimising risk because they do not control the hazard at the source and rely on human behaviour and supervision. These control measures should only be used:

- to supplement higher level control measures (as a back-up),
- as a short-term interim measure until a more effective way of controlling the risk can be used, or
- when there are no other practical control measures available (as a last resort)

4.4 MAINTAIN AND REVIEW THE CONTROLS

Controls should be monitored on a regular basis to ensure their effectiveness. Standard monitoring methods include: creating exclusion zones such as:

- Routine inspection and testing
- Preventative maintenance
- Regular auditing programs

5. DUST AND IGNITION CONTROL

Dust control and ignition control are fundamental to reduction of wood dust fire and explosion risk.

5.1 DUST CONTROL

Elimination of potential for dust buildup is the first thing to consider. For example, can infrastructure be designed and built to remove the possibility of dust build up, like:

- Limiting or restricting dust migration
- Installing ducting and extraction systems
- Tight fitting covers, with gaskets or access doors on enclosed equipment
- Installing cable trays vertically rather than horizontally where possible
- Mesh platform construction
- ‘V’ capping on beams and other horizontal surfaces

Housekeeping

Good housekeeping practice equates to reduced risk of fire or explosion. The presence of sawdust throughout a building, particularly on structural elements such as beams or equipment, can result in explosions. Consequently housekeeping, particularly for elevated and hidden surfaces, is essential. Note that effective housekeeping (whilst technically an administrative control measure) reduces dust as a potential fuel source and so removes one side of the fire triangle. It is therefore critical to ensure that practices are maintained.

Cleaning frequency for maintaining acceptable dust accumulation levels will be dictated by the specific qualities of the dust produced and so it is advisable to seek qualified advice. Safe cleaning methods do not send clouds of wood dust into the air. Examples include the following:

- appropriate vacuum systems for dust collection
- washing with water or wet rags
- using soft bristle brooms on telescopic poles to clean high areas

Low pressure compressed air with suitable high flow nozzles should only be considered as a last resort and used in localized or isolated areas to avoid sending clouds of combustible wood dust into the air.

Stockpile management

As part of a housekeeping program, proper maintenance of any wood waste piles should be prioritised. Not only is wood waste a potential fuel source for external ignition sources, but wood waste (typically bark) also gives off its own heat while decomposing, that can result in a fire due to spontaneous combustion.

- Stockpiles of sawdust and woodchip should be located away from buildings or stored in containers/ buildings etc. designed for wood dust storage
- Stockpiles should be monitored for temperature build up and signs of combustion. Fixed or drone operated thermal imaging can look for hotspots in a stockpile
- Stockpiles can be turned over to prevent temperature build up
- Where possible, stockpiles should be completely removed, and a new stockpile made at regular intervals

5.2 IGNITION CONTROL

Potential ignition sources

- Naked flames, smoking, pilot lights
- Portable electrical equipment such as tools, radios, and fans
- Fixed electrical systems and powered circuits with potential for arcs, sparks, short circuits
- Hot work activities such as welding, hot-cutting, grinding
- Operating equipment with combustion engines such as forklift trucks, generators, compressors
- Hot surfaces, exhaust pipes, hot flues and ducts, and frictional heating e.g. failed bearings or high-speed planer lines
- Mechanical sparks from impacts, e.g. forklift tynes on concrete
- Static electricity leading to electrostatic discharges generated incidentally or by processes or activities (e.g., ducting not grounded and bonded)
- Substances susceptible to spontaneous combustion including: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ISOLATE DOORS BEFORE ENTERING
DOOR UP
DOOR DOWN
ENSURE TO LOCK OUT PNUEMATICS AND HYDRAULICS BEFORE ENTERING INTO THE SAW BOX.
.....THANK YOU

- Substances susceptible to spontaneous combustion including:
    - Rags contaminated with hydrocarbons or solvents
    - Solid fuel piles e.g. heat plant fuel (mixture of green and dry sawdust), heating pel lets (biomass pellets)
    - Wood chips, hogged wood waste and bark piles
    - Wastepaper bales
    - Other flammable chemicals

Ignition controls

Controlling potential sources of ignition in a hazardous area may be achieved by:

- ensuring electrical equipment is effectively maintained where poorly maintained electrical equipment can present a significant risk for example through worn brushes
- ensuring electrical equipment is properly earthed
- use of suitably rated electrical equipment (e.g. intrinsically safe or flame-proof)

NOTE:

Where electrical installations or equipment are required to be located or used in a hazardous area e.g. lighting, mixers and stirrers, pumps, control systems, forklift trucks, detectors, torches etc, these items must be designed and constructed so that they cannot release energy within the hazardous area that is sufficient to cause an ignition. That is, such equipment must be suitably rated for use in a hazardous area.

Refer to EEHA (Electrical Equipment Hazardous Areas) WHS regulations or AS/NZS standards i.e. AS/NZS4761 – Competency standards for working with electrical equipment for hazardous areas.

The type of Zone applying to a hazardous area will govern the level of explosive (Ex) rating required for the potential ignition source, e.g., electric motors.

A Hazardous Area Verification Dossier (Dossier) is a set of documents showing the compliance of electrical equipment and installations. The creation of the Dossier will normally require the help of specialists in consultation with the occupiers of a facility. Dossier requirements are specified in AS/NZS 60079.14 & 17.

A Hazardous Area Verification Dossier must be kept at each facility where Hazardous Area rated equipment is located.

- ensuring that preventative maintenance tasks and statutory inspections on equipment are conducted and corrective maintenance is completed to prevent friction and heat build-up
- implementing safe work systems such as permit systems preventing hot work (for example, welding) in hazardous areas. Guidance to the precautions to be taken as part of a hot work permit system can be found in AS 1674.1-1997 Safety in welding and allied processes - fire precautions
- ensuring high speed equipment is setup and calibrated correctly to prevent heat build-up through friction
- spark extinguishing or wetting systems

- appropriate location and storage of flammable materials
- appropriate location of battery charging stations i.e. floor sweepers, electric forklifts, hand tools / strapper
- prohibition of smoking in and around hazardous areas

6. GENERAL GUIDANCE ON DAMAGE MITIGATION

Regardless of controls put in place to prevent incidents occurring, they can still occur. It is therefore necessary to be prepared for any foreseeable incident.

Up to date Emergency Management Plans and Business Continuity Plans should specifically consider dust explosion events.

AS 3745:2010 Planning for Emergencies in Facilities provides a framework that is recommended as a reference when developing your workplace plans for emergency management. It lays out how to meet Safework Australia's model Code of Practice - Managing the Work Environment and Facilities, which is a set of pragmatic guidelines to assist your compliance with the Workplace Health and Safety legislation.

7. TRAINING AND AWARENESS

Employers are responsible for ensuring workers are properly instructed and trained on how to do their work safely.

Workers must know all relevant health and safety information about their jobs, their workplace, the hazards, and how to control the risks.

Training and instruction must be easy to understand, even for those whose first language is not English and those who have additional needs such as literacy and hearing difficulties.

This can be accomplished by ensuring that workers are:

- fully inducted into the workplace
- trained and competent in Standard Operating Procedures and high-risk processes, including formal training where that is required
- aware of leadership expectations, behaviour protocols e.g. smoking, and adherence to standards, e.g. housekeeping
- adequately supervised by qualified workers
- provided with regular refresher training, both formal and informal e.g. equipment competency assessments, toolbox talks

8. REFERENCE'S AND OTHER GUIDANCE MATERIAL

- Safework Australia
- Australian Standards
    - AS/NZS 3000:2018 Electrical Installations
    - AS/NZS 4745:2012 Code of Practice for Handling Combustible Dusts
    - AS/NZS 60079.10.2 Explosive atmospheres Part 2: Classification of areas - Explosive dust atmospheres
    - AS/NZS 60079.14 Explosive atmospheres Part 14: Design selection, erection and initial inspection
    - AS/NZS 60079.17 Explosive atmospheres Part 17: Electrical installations inspection and maintenance

- AS 1674.1-1997 Safety in welding and allied processes - fire precautions
- AS 3745:2010 Planning for Emergencies in Facilities

- Checklists – a sample risk assessment for combustible dust is provided at Annex A
- International resources of assistance

(US) NFPA 664 - Standard for the Prevention of Fires and Explosions in Wood Processing and Woodworking Facilities

Managing Hazardous Areas (HA) Technical Guide - CSIRO"

WorksafeBC Dust Explosion video

Link to news story "Deadly Mills"

9. ANNEX A – SAMPLE DUST RISK ASSESSMENT

Sample Combustible Dust Risk Assessment