Fire prevention and safety

Safe operations management practices

TOOLBOX

GREENHOUSE CONSTRUCTION AND SAFE OPERATION

Common causes of fire

Understanding the nature of fire is crucial to applying appropriate farm and risk management techniques to protect your greenhouse or grow structure. Each growing activity should be considered in these structures.

Fire is dependent on the presence of three elements; heat, oxygen and fuel. The quantity and availability of each element directly determine how easily a fire ignites, spreads and its duration. Removing one of the elements ensures the fire cannot start or survive.

Figure 1: Elements of a fire

Heat and ignition

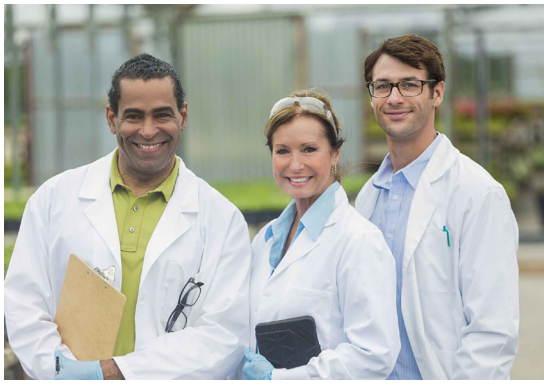
Influence on fire: heat causes ignition of a fire load and can be produced by several forms of energy that are commonly found in a greenhouse or farm building.

Sources include, but are not limited to:

- **Hot work**: sparks and molten metal can easily ignite combustible materials such as plastic membranes from welding or soldering, as well as combustible engine (tractor) exhaust
- **Heating**: natural gas or oil heaters, CO2 generators and any other combustion burning equipment within a greenhouse can create a fire without appropriate clearance to combustible material
- **Electrical**: faulty installation, physical wear and deterioration, and overloading electrical equipment can cause sparks and heat to ignite a fire. Even professionally installed electrical work can become faulty due to overloading or physical damage
- **Smoking**: discarded cigarette butts usually cause a fire risk when policy and designated smoking areas are not provided by the employer
- **Spontaneous combustion**: occurs by self-heating followed by a thermal runaway and finally ignition. For example, the storage of oily rags absorbing oxygen from the air and generating enough heat to combust
- **Accidental**: natural occurrences such as lightning strikes, bushfires and associated ember attack, or power surges to equipment, as well as criminal acts like arson.

KEY MESSAGES

- Greenhouse fires are a significant threat and prevention is preferred to remedy
- Fire is dependent on the presence of heat, oxygen and fuel that govern how easily a fire ignites, spreads and its duration
- Fires can be prevented through good farm management practices relating to: technical standards, building materials, compartmentalisation, power delivery, lights, maintenance of equipment, and fire and smoke early warning detection
- Develop an Emergency Response Plan to ensure all staff know what to do in the event of a fire or other emergency to protect human safety and reduce loss and damages



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Oxygen

Influence on fire: oxygen has a large influence in the speed of spread of fire and the severity of the fire damage

Sources include, but are not limited to:

- **Incorrect installation of mechanical ventilation systems**: tend to exacerbate a fire. The installation of automatic ventilation systems that do not have fire failsafe systems should be an area of consultation with a professional fire engineer and/or fire department official
- **Combustible linings**: in the walls and roof may fail if exposed to heat and allow the fire access to more oxygen, as opposed to solid roofing and walls that may restrict air flow.

Fuel

Influence on fire: fuel influences the duration of a fire, with combustible components and materials stored within the greenhouse acting as fuel, as well as the greenhouse itself

Sources include, but are not limited to:

- Non-permeable membrane: all polymer coverings are combustible, some coatings on glass panes are also combustible
- Permeable membrane, sequential curtain and ground covers
- Timber or plastic benches, work tables and storage racks
- Plastic or polystyrene grow containers
- Fertilisers, typically nitrogen based
- Dried vegetation, plants, grasses and leaf matter
- Oils, petroleum, diesel, propane/ natural gas stored inside or around the structure perimeter
- Vehicles and machinery
- Electrical systems, cabling and lighting.

Fire prevention through good farm management

Technical standards

A well-designed greenhouse or grow structure can be the most effective way to reduce the risk of a fire. This will depend on the type of structure, size, location and compliance to relevant regulation. Make sure you use qualified licensed professionals for all design, equipment installation and repairs.

It's important to identify what will be required of you during the preliminary stages of development. Many local councils are not experienced in development applications relating to greenhouses or certification of greenhouses. Documents to be brought to the attention of the certifier include the Internal Building Code administered by the International Code Council.

Once occupied, good housekeeping standards and enforcing these standards are the best way to prevent fires from ignition or accidently starting. Most local fire brigades are able to provide information and advice to support you.

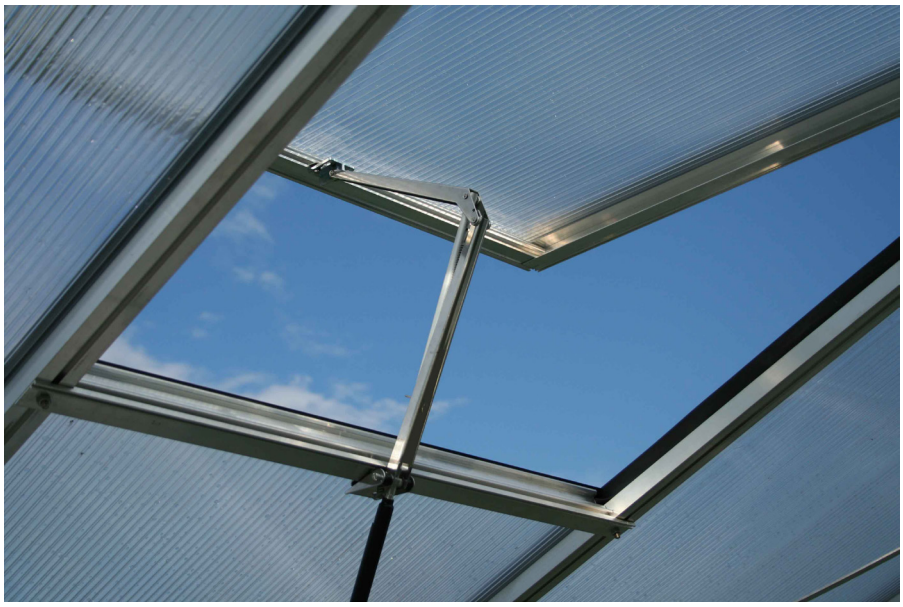
Read the toolbox fact sheet *Local government approval processes* in this series for further information.

Building materials

Greenhouse and grow structure materials vary considerably, and all have a different impact on fire risk. The most common Australian building materials are glass, film plastic membrane, sheet plastic membrane and metal framing as outlined in Table 1 below.

Table 1: Material fire loading and desription

MATERIAL TYPE	DESCRIPTION	FIRE LOADING
Glass	Tempered or non-tempered glass (soda-lime glass), melting point of approximately 1,400°C in accordance with AS 1288 Glass in Buildings and AS 2047 Windows in Buildings	Not combustible and does not spread flame, unless they have been laminated with a film that may be combustible
Film plastic membrane (FPM)	Single layer plastic film is commonly polyethylene, EVA or PVC between 150 to 200 microns thick. Includes impermeable membrane, permeable woven netting or shade cloth, and shade or energy curtains	Combustible and need to be protected from high heat sources and open flames, particularly the edges which are more susceptible than the flat surface. Can spread fire quickly due to melting and dripping onto other combustible material below (e.g. polystyrene boxes)
Sheet plastic membrane (SPM)	Commonly polycarbonate, acrylic and fibreglass that come in corrugated sheets or twin-wall panels	Flame-retardant and considered to be non-flammable (most commonly), which should be confirmed with the manufacturer
Metal framing	Commonly steel, aluminium or composite of the two metals	Although flame is unable to spread over metal they are not 'fireproof'. Unprotected metal framed buildings can fail more rapidly than a wooden structure due to rising temperature and structural failure



Separation and compartmentalisation

It's important to separate a greenhouse or farm building to limit your risk of loss. The National Construction Code (NCC) has limitations on how much fire load in a given area can be created. So separation of building, fire breaks, and compartments should be considered. In Group A type buildings, one method is to form two or more sections of your greenhouse with a fire-resistant boundary in accordance with the current, relevant NCC and Australian Standards (accessible online).

To do this:

- Place buildings at three or six metre separations to accommodate both buildings and a fire break to reduce fire spread externally
- Maintain an appropriate distance to vegetation that will reduce the risk of spreading bushfires
- Separate the greenhouse into fire zones based on risk using non-combustible materials as partitions (e.g. fire wall, concrete tilt panels, fire-rated cladding)
- Isolate generators, heaters and boilers from the greenhouse with non-combustible partitions
- Isolate ignition sources such as heating pipes, CO2 generators and other electrical switches from combustible materials.

The greenhouse manufacturer in conjunction with a professional fire engineer (if required) will determine a separation and compartmentalisation strategy best suited to the development based on the information you supply on layout of growing area and plant areas.

Power delivery

Electrical faults and/or misuse of the electricity supply result in many fires. Tips for ensuring safe installation and operation of electrical equipment include:

- Ensure electrical work is undertaken by a professional electrician and compliant with relevant Australian Standards
- Ensure each circuit is protected by a fuse or breaker that will blow if safe capacity is exceeded to reduce the risk of fire from overloading
- Install electrical panels and boxes in the driest and most accessible location within the greenhouse to avoid areas of excessive, prolonged moisture
- Install corrosion resistant and weatherproof electrical panels and boxes
- Consider a secondary power supply panel and disconnect switch outside the structure
- Ensure the installation is verified by a qualified electrical contractor who uses thermal imaging of systems.

Further detail and design guidance can be obtained from a registered professional fire engineer or electrical engineer, and is highly recommended.

Lights

Lights should be protected with a non-combustible conduit (i.e. metal) wherever possible, however lights are not common in Australian greenhouses. They should also be maintained regularly to remove dust and debris and check electrical wiring. When installing lights be sure to:

- Maintain an appropriate distance between lights and combustible materials
- Use a licenced electrician and ensure approved fittings are used

- Replace old or faulty parts with original manufacture approved components.

Maintenance of equipment

General:

- Ensure a maintenance protocol is in place to check mechanical and electrical equipment
- Replace or repair damaged or faulty equipment immediately, or where not possible remove from operation.

Fans and motors:

- Keep the area around fans and motors clear of combustible materials
- Provide appropriate ventilation and maintain regularly to remove dust and debris build up
- Ensure they are installed by a licenced professional and voltage and amperage corresponds to the motor nameplate.

Appliances and tools:

- Service and clean vehicles, including fork-lifts and tractors, to ensure dust and oil does not build up around the engine block and electrical connections
- Service and maintain tools as per manufacturer's recommendations, particularly those that are powered by an internal combustion engine
- Store tools and vehicles that may be hot from operation away from combustible material with adequate ventilation.

Fire and smoke early warning detection

General upkeep:

- Test fire and smoke alarms at regular intervals, the codes in Australia indicate the periods of inspection and testing (AS1851)
- Flush private fire hydrants at least once a year or as instructed by the manufacturer (if installed)
- Check fire doors are performing adequately, are unobstructed and in good condition
- Check all water control valves and air and water pressures of automatic sprinkler and misting systems
- Ensure a licenced electrician checks all wiring, power boards and electrical equipment for faults or deterioration on regular intervals
- Check and maintain all boilers and heating systems to ensure they are in good operating condition.

Fire extinguishers and fire house reels:

- Install fire extinguishers and hose reels in locations instructed by the relevant Australian Standards or professional fire engineer
- Install fire extinguishers near potential hazards (e.g. gas storage tanks, boilers and CO2 generators), aisles and near exterior doorways
- Use the correct fire extinguisher for the type of fire as per Table 2
- Only use fire hose reels when fighting an ordinary combustible fire (wood, paper, plastic and fabric)
- Educate staff on the identification of types of fires, use of equipment, and when to combat fire or evacuate.

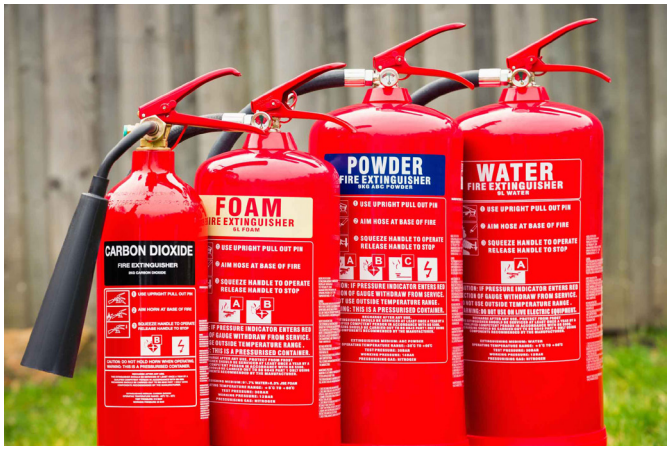


Table 2: Fire extinguisher classes

CLASS	TYPE OF FIRE	APPROPRIATE EXTINGUISHERS
A	Ordinary combustibles (i.e. wood, paper, fabric, plastic)	Water, foam, dry chemical, vaporising liquid, wet chemical
B	Flammable liquids	Foam, dry chemical, carbon dioxide, vaporising liquid, as well as sand cover and fire blankets
C	Flammable gas	Dry chemical, vaporising liquid
E	Electrical	Dry chemical, carbon dioxide, vaporising liquid

Storage of combustibles:

- Locate in a ventilated open outdoor area that is well separated from buildings, streets and property boundaries
- Ensure storage room is labelled and secure
- Document the locations of combustible storage areas in the farm's Fire Prevention and Emergency Response Plan
- Keep an inventory of the type, quantity, date of purchase and location of the chemicals and combustibles
- Ensure electrical services near flammable goods are properly designed and maintained
- Keep the inventory safe and available for inspection by emergency personnel
- Store flammable liquids only in approved containers
- Ensure chemical storage rooms have appropriate ventilation and spill contaminate design in accordance with Australian Standards (where applicable)
- Storage should be in accordance with the National Code of Practice for the Storage and Handling of Workplace Dangerous Goods (see AS1940).

Emergency Response Plans:

- Prepare an Emergency Response Plan to ensure all staff know what to do in the event of a fire or other emergency to protect human safety and reduce loss and damages
- Ensure operation of common alert systems, including:
  – PA systems, sirens or bells clearly audible anywhere on the farm
  – Exit routes from buildings clearly identified on emergency exit plans
  – Exit signs to mark exits (illuminated signs are not required in typical greenhouses)
- Install and appropriately label 'knockout panels' in greenhouse sidewalls and gable ends if required by fire authority
- Undertake one onsite fire and evacuation drill per year in accordance with Australian Standard 3745:2010
- Train staff in how to implement and follow the response plan, including practice of kicking through a knockout panel.

For assistance in developing an Emergency Response Plan you should refer to your state Workplace Health and Safety Commission, complete the checklist developed by Safe Work Australia, or engage a professional fire engineer for a fee.

REFERENCES AND FURTHER READING

Olivotto, M. (2014) Building codes and greenhouse construction, Osborn Lane Consulting Engineers, Warwick

National Greenhouse Manufacturers Association (2010) Fire Safety, Pennsylvania, https://www.ngma.com/standardpdf/FireSafety2010.pdf

Safe Work Australia (2012) Emergency Plans Fact Sheet, Canberra, http://www.safeworkaustralia.gov.au/sites/swa/about/publications/Documents/657/Emergency_plans_fact_sheet.pdf

IMPORTANT QUESTIONS TO ASK

- What are the main risks that could cause a fire in my greenhouse or grow structure?
- Do I need to enlist the services of a professional fire engineer to properly manage fire risk on my farm?
- What measures do I have in place to prevent a fire from occurring?
- Where is the closest fire department located and when did they last tour the site?
- Do I have an Emergency Management Plan in place and when was it last updated?
- Do staff need training for dealing with different fire types?
- What training could I provide employees to maintain a low risk of accidental fires and safe egress?