

Western Australian outdoor fireworks

Code of practice



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Government of Western Australia

Resources Safety 

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Foreword

The Act

The *Dangerous Goods Safety Act 2004* (the Act) provides risk management dangerous goods legislation for the first time in Western Australia. A key focus of this Act is the duty to minimise risk from dangerous goods.

The duty to minimise risk not only applies to employers and employees but to all persons, including members of the public. This duty is placed on everyone involved with dangerous goods and goes beyond the workplace duties of the *Occupational Safety and Health Act 1984* and the *Mines Safety and Inspection Act 1994*. Public safety is one of the most important features of the Act.

Regulations

The Act is supported by the Dangerous Goods Safety (Explosives) Regulations 2007 (the Explosive Regulations). It is essential to understand and comply with this legislation and adopt a risk management approach using all relevant codes and standards.

The Explosives Regulations are enforceable and breaches may result in licence suspension, prosecution, or directions to cease operations and undertake remedial action.

Acknowledgement

Parts of this code of practice are based, with permission, on the *Code of Practice for the Control of Outdoor Fireworks Events*, published in 2003 by the then-Department of Natural Resources and Water, Queensland.

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1 Introduction

1.1 Background

Except for small toy fireworks, such as party poppers and bonbons, the use of fireworks by the general public has been banned in Western Australia since 1967. Only properly trained and authorised people are permitted to handle fireworks.

The emphasis is on developing and implementing risk control measures that, wherever possible, eliminate hazards associated with fireworks or isolate people from those hazards. Compliance with this code of practice will ensure a high standard of safety within the fireworks industry.

In response to the increased threat of terrorism, Australian governments agreed to adopt improved security measures for the explosives industry, including fireworks. Consequently, this code also addresses the security measures now required.

1.2 Application

The management of fireworks in Western Australia is covered by the *Dangerous Goods Safety Act 2004* (the Act) and Dangerous Goods Safety (Explosives) Regulations 2007 (the Explosives Regulations) (see Appendix 1).

This code of practice covers the safe manufacture, importation, transport, storage, handling and use of outdoor fireworks.

It does not apply to:

- theatrical fireworks;
- ceremonial cracker chains;
- parachuting with pyrotechnics;
- model rockets;
- use of pyrotechnics for non-recreational purposes (e.g. scientific demonstrations, distress flares); and
- unrestricted fireworks (Appendix 2).

Note: Some fireworks and equipment are prohibited (Appendix 3).

Note: Other legislation, standards and codes may also apply to outdoor fireworks activities, and other agencies may need to be consulted.

1.3 Adopting a risk management approach

The *Dangerous Goods Safety Act 2004* advocates a risk management approach to minimise risk from dangerous goods (including fireworks) to people, property and the environment.

Hazards need to be identified and an assessment conducted to determine the associated risk (i.e. likelihood of hazard occurring and potential consequences). The risk assessment may be qualitative or quantitative depending on the level of information available. A

qualitative approach will be adequate in most instances and comparisons may be made against known criteria or available information.

Australian Standard AS/NZS 4360:2004 *Risk management set* describes the elements of risk management and the process used to identify controls to either eliminate or reduce risk to an acceptable level. Further information on how to adopt risk management principles is summarised in Appendix 4.

Risk management principles may be applied to all activities associated with fireworks such as import, manufacture, storage, transport, testing of fireworks, storage and set up prior to the fireworks event, use during the event, and the after-event activities to ensure the area is safe for the public to enter the area again.

1.4 Alternative safety measures

This code of practice sets minimum requirements that provide an acceptable level of risk. However, it may be possible, under some circumstances, to operate at the same or a lower level of risk using alternative safety measures. The code is not intended to prevent innovative safety measures, and other practices and equipment that give at least equivalent safety performance may be considered.

1.5 Responsible people

People directly associated with fireworks have a duty to minimise risk. As well as the contractors and operators, this includes people engaged in:

- design and construction of fireworks;
- design, construction and manufacture of fireworks equipment;
- purchase of fireworks; sale or supply of fireworks;
- sale or supply of fireworks equipment; storage of fireworks; and
- transport of fireworks.

The general *duty to minimise risk* for people associated with fireworks includes:

- protecting the health and safety of other people and themselves;
- protecting property and the environment;
- ensuring that all people directly associated with the handling, storage, use and transport of fireworks are not under the influence of:
 - alcohol;
 - banned drugs; or
 - medication that significantly affects a person's performance and judgement;
- being an appropriate person (i.e. physical ability, mental fitness and criminal history);
- controlling ignition sources within the vicinity of fireworks at all times;
- not engaging in inappropriate behaviour, such as skylarking;
- having the appropriate competencies and training to perform the duties associated with fireworks safely and securely; and

- a commitment to follow rules and adopt high safety and security standards.

Contractors and operators should also ensure that they have the appropriate licences, permits and insurance to conduct an event (see Figure 1.1).

Further information on the licensing system is available from the Resources Safety website at www.docep.wa.gov.au/ResourcesSafety in the dangerous goods section.

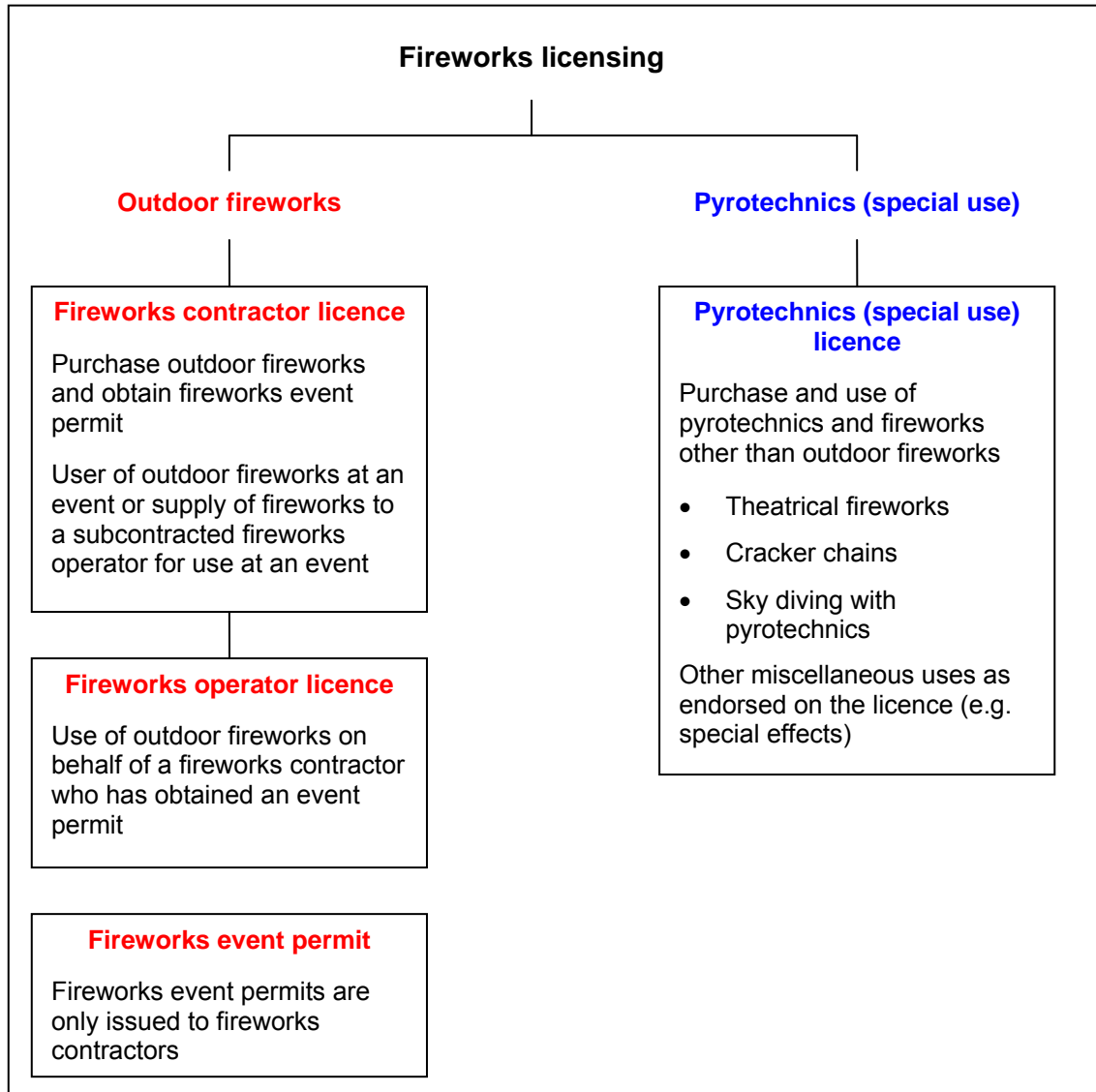


Figure 1.1 Licensing and permit system for fireworks used in Western Australia

2 Regulatory requirements for use of fireworks

2.1 Licensing requirements

To legally use outdoor fireworks, a person must be authorised for that activity and licensed as a fireworks contractor or fireworks operator.

A fireworks contractor is the person who controls and organises the fireworks event.

A fireworks operator is the person who conducts the event.

If the contractor is an individual, he or she must also be a licensed fireworks operator.

If the contractor is a body corporate or partnership, at least one individual in management or employed by the body corporate or partnership must be a licensed fireworks operator.

Preparation of an explosives management plan is a prerequisite for obtaining a fireworks contractor licence (see Section 2.4).

Detailed information on the licensing system, including the explosives management plan, is available from the Resources Safety website.

2.2 Licensing endorsements and restrictions

A contractor or operator must comply with the licence conditions. The licence may prescribe one or more categories of fireworks use and may limit the size of aerial fireworks.

Contractors or operators limited to ground level outdoor fireworks must only use:

- lances (of any size);
- fountains with an internal diameter no greater than 125 mm;
- barrages (pre-loaded, chain fused shells in non-reusable mortars) up to 50 mm diameter (or length if shells are cylindrical);
- mines, Roman candles, comets and other ground fireworks less than 75 mm diameter;
- multishot cakes up to 50 mm diameter; and
- cracker chains and distress signals if required.

Contractors or operators endorsed to use restricted aerial shells who wish to upgrade their endorsement to a larger shell size will need to demonstrate (e.g. using records and other documentary evidence) experience and competency firing aerial shells under their existing endorsement that are commensurate with the increase in hazard.

In order to gain experience, an operator at a lower level of endorsement may initiate fireworks that require a higher level of endorsement provided it is under the direct supervision of a licence holder having the correct level of endorsement.

An employee or agent of a contractor (e.g. an operator and assistants) may only possess fireworks relating to the contractor's activities.

Restricted and prohibited explosives

Black powder and flash powder

Loose black powder and flash powder are classified as 1.1D and 1.1G explosives, respectively. To possess or use these powders, a person must be authorised to carry out blasting or special effects, or manufacture explosives. A contractor or operator licence is not an authority to possess or use loose black powder or flash powder.

Prohibited explosives

Blasting explosives such as detonators, detonating cord and packaged blasting explosives are not to be used in public events without the Chief Officer's prior approval.

2.3 Training and competency of personnel

The contractor must ensure that the operator, their assistants and any other personnel involved in the event, such as security staff, are competent and suitably trained (may be on-the-job training) to safely undertake their tasks.

Operators should complete the introductory training program for volunteer fire fighters presented by Fire and Emergency Services Authority of Western Australia (FESA) or an equivalent.

The operator should also hold a current first aid certificate from a recognised service provider (e.g. St John Ambulance Western Australia; Australian Red Cross First Aid).

Contractor

A contractor needs competencies in:

- conducting fireworks events;
- undertaking risk identification, risk assessment and risk management; and
- implementing an explosives management plan.

Operator

An operator needs to know about:

- legislative requirements for storage, transport and use of fireworks;
- hazards of the fireworks types, their firing characteristics, safe handling procedures and methods of use; and
- emergency procedures, including handling misfires and fireworks disposal.

2.4 Explosives management plan

General requirements

Before a contractor licence can be issued, a written explosives management plan must be submitted with the application and deemed adequate. The explosives management plan must:

- demonstrate that the relevant safety and security risks have been adequately assessed; and
- provide assurance that measures are in place to minimise those risks (e.g. risk minimisation measure, emergency response).

Detailed information on the licensing system, including the explosives management plan, is available from the Resources Safety website.

Safety

An assessment of the risk of an event to people, property and the environment must be conducted, and control measures identified to ensure that:

- personnel are competent and trained in the safe use of fireworks;
- fireworks and equipment to be used in an event have been properly maintained and tested; and
- procedures are implemented for safe conduct before, during and after the event.

Security

In order to ensure that unauthorised people do not possess fireworks, the risks of theft, sabotage or unexplained loss, and measures to keep explosives secure, must be assessed.

Records must be maintained of people who have access to fireworks.

People with 'unsupervised' access must have a valid dangerous goods security card.

Any theft or loss of fireworks must be reported to the Western Australia Police (WA Police) and Resources Safety as soon as practicable after detection.

Emergency response

In the event of an incident involving fireworks, the contractor must ensure that equipment and resources are available to minimise or mitigate the damage to people, property and the environment.

2.5 Event permit

Each fireworks event organised by the contractor requires a firework event permit (Section 8.2). A fireworks event permit may relate to more than one event at the one place if the event will be repeated at the place on a number of occasions at intervals of not more than 48 hours.

Detailed information on the permit system is available from the Resources Safety website.

3 Classification and packaging of fireworks

3.1 Classification system

All outdoor fireworks must be classified in accordance with United Nations (UN) principles, using the UN default classifications detailed in Appendix 5.

Table A5.1 should be used to determine the classification of mixed fireworks (i.e. when more than one type of firework is packaged, stored or transported together).

3.2 Approved packages

Packages of fireworks must be properly marked and labelled, and the packaging approved according to the UN tests outlined in the *Australian Dangerous Goods Code, 7th Edition (ADG7)*.

Design of packaging

Packaging

Table 3.1 summarises the markings required on packages of fireworks. Packaging consists of outer packaging (e.g. outer cardboard box), inner packaging (e.g. paper bag) and the wrapping around the fireworks article itself.

Note: Inner packaging is often not used and marking is not required when the inner packaging is transparent.

Table 3.1 Markings required on fireworks packages

Packaging component	Marking requirements
Outer packaging	<ul style="list-style-type: none">• Authorised name• Proper shipping name and UN number• Class label• 'EXPLOSIVE' label• Production details (e.g. batch details)• Contact address in Australia• Packaging performance and specification markings
Inner packaging	<ul style="list-style-type: none">• Authorised name• Class label
Wrapping	<ul style="list-style-type: none">• 'EXPLOSIVE' or 'FIREWORKS' label• Authorised name (if sufficient space)

Package markings

The package markings must be:

- printed in English, readily visible and legible;
- able to withstand open weather exposure without a substantial reduction in effectiveness;
- displayed on a background of contrasting colour on the external surface of the package; and
- located on the packaging so as to be normally visible when the package is stacked with other packages of the same kind.

The prescribed package markings must not be located with other package markings that substantially reduce their effectiveness. They are usually displayed on three sides to be readily visible.

The outer packaging must be clearly marked on the outside surface with:

- proper shipping name and authorised name; i.e. the word 'FIREWORKS' and the UN number of the fireworks in the package (when there is more than one type of firework in the package, details for each type of fireworks in the package must be marked on the outside surface of the package);
- class label appropriate for the fireworks in the package where there is more than one hazard division in the package (see Appendix 5);
- contact name and address of the manufacturer, consignor or agent in Australia; and
- packaging performance and specification markings.

Class labels and lettering

The lettering on the class labels must meet the size and height requirements indicated in Table 3.2.

Table 3.2 Size of class labels and height of lettering on packaging

Quantity of explosives in package	Minimum size of class labels	Minimum height of lettering
≤ 0.5 kg	15 mm	2.5 mm
> 0.5, ≤5.0 kg	20 mm	3.0 mm
>5.0 kg	100 mm	10.0 mm

Packaging performance and specification markings

The letters, numerals and symbols shown in Figure 3.1 are the packaging performance and specification markings, and represent the following:

- circular logo is the official UN packaging symbol;
- 4G is the type designator for the packaging (4 = box and G = fibreboard);
- Y refers to packaging group II specifications (X, Y, Z = I, II, III respectively);

- 10 refers to 10 kg (gross weight or density for liquids);
- S refers to solid (hydraulic pressure test in kPa is given for liquids);
- 06 refers to 2006 (year the packaging was manufactured);
- AUS means that the packaging was authorised in Australia; and
- 9014 refers to the competent authority approval identification.

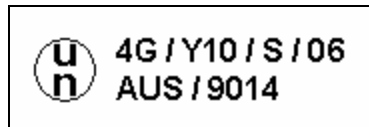


Figure 3.1 Example of packaging performance and specification markings

The type designators comprise a number for the packaging type and letter for material type. The packing designators for boxes and bags are 4 and 5, respectively. Common material designators are C (natural wood), D (plywood), G (fibreboard or cardboard), H (plastic) and M (paper).

Note: See the Australian Explosives Code for the lettering size requirements for packaging performance and specification markings.

Marking of superior packages

Superior packages, such as wooden carry boxes, must be marked with a 100 mm Class 1 label (orange 'diamond') and the word 'FIREWORKS' (or other wording as appropriate) marked in lettering at least 75 mm high. Where more than one hazard division of fireworks is in the carry box, the Class 1 label must be determined as described in Appendix 5.

Repackaging

Packaging approval usually applies to a carton packed with one firework type as supplied by the manufacturer (e.g. carton of cakes of one product code). These cartons are not approved if repackaged as a combination of different fireworks. However, transport of selected orders in approved packages (including cartons that have been repackaged with other combinations) is permitted in Western Australia provided the packages are:

- fully taped closed; and
- marked and labelled for the contents in the package.

Fireworks with electric matches

Fireworks that have been fitted with electric matches have an increased risk of ignition arising from the match head. The packaging approval is not valid unless the packaging approval test included testing with fused fireworks.

To overcome the increased risk from fusing of the fireworks, additional risk control measures must be adopted for fireworks prepared in the workshop, such as:

- introducing additional packaging materials and methods to protect the electric match from ignition due to friction impact and induced currents; or

- packaging in a superior package such as a day-box for transport to the set up area.

3.3 Labelling of fireworks

General

All fireworks must be labelled to provide identifying information, safety information and instructions. The required information must be printed:

- within a border;
- in English; and
- in a colour sharply contrasting with the background.

All fireworks must be identified with the information outlined in Table 3.1. Labels must unambiguously convey the required information using either words in plain English or graphics on a contrasting background, and must be readily visible and legible.

If any labelling is wrong or missing, the supplier must make corrections using adhesive labels. If the manufacturer's batch or lot marking details are absent, the supplier should assign a batch or lot number. This lot or batch number must be legitimate within the principles of lotting and batching. For example, the batch number would be of the type and model of firework from the same source or origin.

Aerial shells

As a minimum, each aerial shell must also be labelled with the following information:

- description of the size of the aerial shell in terms of the internal diameter of the mortar to be used (e.g. '75 mm AERIAL SHELL');
- description of the type of aerial shell (e.g. 'TO-BREAK WITH REPORT' and the label or wrapper of any type of aerial salute must be conspicuously marked with the word 'SALUTE'); and
- an instruction advising the correct direction of firing by the phrase and symbol 'THIS WAY UP ↑'.

Ground fireworks and cracker chains

Fireworks (including cracker chains too small to carry a label) may be labelled only on an outer pack, provided that they are sold in the outer pack only and not as unmarked single items.

The contractor must ensure through the explosives management plan that risk control measures are implemented to ensure unlabelled fireworks cannot leave their direct and immediate control at the event.

Fireworks sold individually must be labelled individually. The labels must contain the following information:

- instructions for use;
- appropriate warning; and
- description of the principal effect of the firework after ignition.

4 Supply of fireworks

4.1 Importing fireworks

General requirements

An explosives import/export licence is required to import fireworks from another country. An explosives import notice must be given to the Chief Officer at least seven days before the expected time of arrival in the State.

An explosives transport licence holder who imports a firework from interstate must give the Chief Officer a fireworks (interstate import) notice at least 24 hours before the expected time of arrival in the State.

Detailed information on the licensing and notification system is available from the Resources Safety website.

Authorised fireworks

Only authorised explosives, as listed in the Western Australian Government Gazette, may be imported into Western Australia. However, there are many kinds of fireworks and it is not unusual for the composition, packaging or name of a firework product to change at short notice, so the normal authorisation system used for other explosives is impractical for fireworks.

Consequently, the Chief Officer has generically authorised all outdoor fireworks in Western Australia but contractors must still meet two requirements. The imported fireworks must be:

- classified by the contractor in accordance with the UN default fireworks classification table (Table A5.4); and
- tested by the contractor in accordance with Section 4.4.

Fireworks coming into Western Australia may only be supplied or used once they have been properly classified and tested. The contractor will require documented evidence that the above two conditions have been met. If fireworks are imported by a contractor, they may be supplied directly to subcontracted operators, or sold to other operators under an explosives supply licence.

4.2 Manufacturing fireworks

An explosives manufacture licence is required for any operation involving:

- manufacture of fireworks devices;
- a step or process for producing a firework (e.g. star composition mixing);
- alteration of the chemical or physical properties of a firework;
- possession of pyrotechnic compositions or stars of any kind unless specifically authorised to do so;
- re-use of tubes from fired items designed for single use (e.g. multishot items); and

- use of fireworks to produce effects in a manner other than as intended or specified by the original manufacturer.

A written explosives management plan must be submitted as part of the licence application. Information on the licensing system, including explosives management plans, is available from the Resources Safety website.

The following modifications to fireworks may be done without a licence to manufacture fireworks provided standard operating procedures (SOPs) are prepared by the contractor:

- breaking down multishot cakes into smaller cakes; and
- removing, modifying, weighing or replacing the lift charge from aerial shells.

Note: Procedures for fitting igniters and fusing devices (e.g. attaching and removing fuses, quickmatch and electric matches) will need to be included in an explosives management plan.

4.3 Design and construction of fireworks

General safety requirements

Fireworks must function in a safe and predictable manner. They must:

- be designed such that they are not likely to cause injury or damage when transported, handled, stored, used or disposed of in accordance with the instructions provided;
- be designed and constructed so that, upon ignition, the firework case does not rupture unless intended to do so; and
- not contain any mixture of an unstable, toxic or highly sensitive nature that may result in an unsafe firework.

Consideration must be given to:

- ignition method and fuse burning time;
- fireworks composition;
- explosive content;
- construction type and integrity;
- performance of the firework;
- debris characteristics;
- shelf life, including safety with respect to time;
- size of the area affected during the functioning of the firework; and
- fire, safety and health risks posed by the firework or its components or effects.

Fireworks must be constructed so that:

- no fireworks composition can escape during normal handling prior to use; and
- wrapping paper that encases a wick can be easily removed without dislodging the wick from the firework.

Fireworks composition

The firework composition must not contain any mixture of an unstable, toxic or highly sensitive nature that may result in an unsafe firework, such as:

- chlorate salts (see note below);
- mixtures containing arsenic compounds, lead compounds, white phosphorus or mercury compounds; and
- mixtures containing picric acid or salts of picric acid.

Note: Milligram quantities of chlorate salts are permitted in some friction sensitive primer compositions.

Ignition method

The ignition method must be readily identifiable and appropriate, as recommended by the manufacturer or supplier. The time elapsed from lighting to functioning must be sufficient to allow the user to retire to a safe distance but not so long that it may appear to be a misfire. This also applies to the time elapsed between the functioning of successive elements of the firework.

Subject to risk assessment principles, fireworks designed to be ignited by hand should discharge after not less than three seconds for inexperienced operators and not less than one second for experienced operators. Hand lit fireworks should be designed with a delay no greater than ten seconds.

Initiation of other fireworks must be by an appropriate method as recommended by the manufacturer or supplier.

Note: Methods of ignition requiring a flame should be suited to the use of ordinary safety matches.

Additional safety considerations for aerial shells

Aerial shells must be constructed so they fit easily into the appropriate size mortar, and the lift charge and delay fuse selected to ensure that the aerial shell reaches a safe altitude before functioning. Each shell should be constructed so that the difference between the inside diameter of the mortar in which it can be safely used and the outside diameter of the shell is:

- not less than 3 mm and not more than 6 mm for shells less than 75 mm diameter; or
- not less than 3 mm and not more than 13 mm for shells larger than 75 mm.

Any pyrotechnic composition must be consumed before falling to the ground and this must be confirmed by testing.

Aerial shells must be classified according to the inside diameter of the mortar in which they can be safely used (e.g. '75 mm aerial shells' is only used for 75 mm inside diameter mortars). Single-break and multi-break salute aerial shells must not exceed 75 mm in diameter or 75 mm in length (exclusive of the lift charge).

The length of the internal delay fuse and the amount of lift charge must be sized to ensure proper functioning of the shell in its mortar. If quickmatch fuse is required, it must be long enough to allow not less than 150 mm of fuse to protrude from the mouth of the mortar after the shell is fully inserted and resting on the bottom of the mortar. A safety cap of a different colour than that used for the paper of the fuse must be fitted over the exposed end of the fuse. The fuse is not to be folded or doubled back under the safety cap.

When hand-firing, the time delay between ignition of the tip of the exposed black match and ignition of the lift charge must allow the operator sufficient time to move away and avoid injury.

Performance

The performance of fireworks must be such that people following reasonable instructions for their use from the information provided (see Section 4.6) and observing the fireworks are not, as far as is practicable, exposed to unacceptable risk of harm. Similarly, there should be no appreciable risk to property or the environment.

The minimum clearance distance for the exclusion zone from which it is safe to conduct or watch the event is determined by aspects such as how far projectiles and burning debris are thrown and the size of the area affected during the functioning of the firework, including contributing effects from wind and angling.

A firework must not project all or any part of itself through the air in an erratic and unpredictable manner.

4.4 Fireworks testing

General requirements

The holder of a fireworks event permit must not use an event firework, or allow an event firework to be used, at the event to which the permit relates unless the holder:

- has previously properly tested a firework that he or she is satisfied on reasonable grounds is identical to the event firework; and
- is satisfied by the test that a firework that is identical to the one tested would be safe to use at a fireworks event.

Testing should be conducted using a risk management approach and in accordance with an explosives management plan.

Testing must not be undertaken at a public event and the owner of the test site must consent to the activity.

Chemical tests

Qualitative chemical tests may be carried out to establish or confirm the composition of the product.

Any chemical testing should be carried out by a competent person or accredited certification body.

Safety and performance tests

The importer or supplier for each different consignment and type of fireworks must undertake safety and performance testing not more than twelve (12) months before their supply.

Additional performance testing may be carried out on stock held for more than twelve (12) months or at other frequencies determined by the manufacturer.

Additional safety and performance tests

Additional safety and performance testing must be undertaken whenever circumstances occur that may affect the performance of the fireworks. For example:

- stored fireworks can suffer from moisture absorption or desiccation; and
- climatic effects caused by transporting fireworks from a temperate to a tropical climate can adversely affect their performance.

Additional testing should also be undertaken upon receiving reports (e.g. from the operator) that a firework has malfunctioned.

Test location

A firework is not properly tested unless the firework is used at a place where:

- public is not present;
- firework can be used safely;
- effects of the use of the firework can be observed safely; and
- any risk to people, property and the environment, including any risk from a malfunction or initiation, is reduced as far as reasonably practicable.

Ideally, the test should be conducted on level cleared ground, in an area with a radius of at least ten metres. The test location should have an exclusion zone at least 25% larger than the exclusion zone required for the conduct of a public event.

The fireworks must be prepared in accordance with the instructions supplied.

Note: A fireworks exclusion zone at a public event is not a test facility.

Test procedure

Testing comprises a series of destructive and non-destructive tests on a batch or lot of fireworks. Sampling procedures and sample sizes should be based upon recognised standards.

Different fireworks of the same size and genre produced by the same manufacturer may be tested using one firework as representative of the others. For example, a manufacturer may supply 75 mm shells that produce red, green or yellow colours. A test on one colour can be taken as representative of all three colours without having to do a different test for each colour. However, fireworks that produce white colours usually have more metal powder in their composition and may not be representative of other colours.

Physical examination and test firing

The person in charge of the testing must be competent in testing fireworks and in applying the requirements of this code of practice.

A test plan should be developed to ensure that all features for compliance are being measured to the desired level of accuracy and recorded for assessment against the acceptance criteria. Examples of tests to be conducted on sampled fireworks for the testing plan are:

- examining the labelling of the firework to ensure that it meets requirements;
- examining the firework and its packaging for escaped fireworks composition;

- examining the structural type and integrity of the firework;
- measuring and recording the effects of the firework when functioning to determine how high and how far laterally stars, sparks or debris are projected;
- measuring and recording any debris falling outside the exclusion zone that is not composed wholly of paper, cardboard, fabric, plastic-foam or clay; and
- measuring and recording the weight of any piece of paper, cardboard, fabric, plastic-foam or clay that falls outside the exclusion zone.

Explosive content and weight

Testing should validate the explosive content and expected range in weight for the hazard division classification and net explosive quantity (NEQ) calculations.

Records of testing

Results and methods of testing must be documented and kept for not less than three years after the last stock is sold. Records of testing by must be available to Resources Safety for validation and confirmation prior to distribution of the fireworks.

Appendix 6 is an example of a checklist that may be used for a fireworks performance test.

Acceptance criteria

Fireworks must comply with the acceptance criteria for the safety and performance features published in the material safety data sheet (MSDS) and technical data sheet (TDS). Both destructive and non-destructive tests should be used.

4.5 Provision of information to user

Scope of information

Information detailing the safe handling, transport, storage, use and disposal of the firework must be provided to all purchasers of fireworks.

All information and instructions must be in English, easy to comprehend and legible.

Material safety data sheets and technical data sheets

The manufacturer and supplier must ensure that an MSDS and TDS are available for each firework type. These documents provide the contractor with information to:

- determine work practices for safe operating procedures;
- conduct a risk assessment when planning the fireworks event; and
- calculate minimum clearance distances.

Where appropriate, an MSDS or TDS may be used generically, such as for certain types of fireworks with similar characteristics and features.

Specific information

Information about the most appropriate method of transporting fireworks within a vehicle must include:

- location within the vehicle;
- securing the fireworks; and
- segregation and separation from incompatible substances.

Information about the most appropriate method of storing fireworks must include:

- segregation and separation from incompatible substances;
- separation from ignition sources;
- keeping in a locked box;
- keeping away from children; and
- keeping away from foodstuffs.

5 Storage of fireworks

5.1 General requirements

Application

An explosives storage licence is required for most fireworks except for:

- storage of unrestricted fireworks (Appendix 2);
- storage of 1,000 kg or less of sparklers (where the combustible part is more than 300 mm long); and
- limited storage by a contractor or operator (Table 5.1) where the contractor or operator's licence allows it.

Table 5.1 Maximum quantities of fireworks for limited storage

Hazard division	Maximum quantity (kg)
1.1 or 1.2	2.5
1.3	15
1.4	30

For unrestricted fireworks and quantities of less than 1,000 kg of sparklers, basic safety precautions should be observed (e.g. control of ignition sources).

For limited storage by licensed users, fireworks must be:

- kept at ground level in a secure structure that is not a dwelling or shop and separated from inhabited buildings and other dangerous goods;
- locked inside a wooden or wood-lined metal box painted white with the word 'FIREWORKS' in red lettering at least 75 mm high;
- kept at least five metres from ignition sources;
- kept at least five metres from flammable or combustible substances; and
- stored in a tidy state.

A means of fighting fires (e.g. nearby garden hose) is recommended for limited storage.

For all other storage situations, magazines must meet the requirements of Australian Standard AS 2187.1:1998 *Explosives – Storage, transport and use – Storage or Appendix 7* (only applicable for certain kinds of fireworks).

Separation of storage from other activities

Fireworks must not be packaged, unpacked or repackaged in the storage area. Fireworks cartons must not be opened nor orders selected from opened packages within the storage area. The packages must be moved to a separate area away from the storage area where orders may be selected.

The fireworks preparation site must not be in a direct line of sight to either magazine doors or vehicles loaded with fireworks that are within 30 m of the magazine.

Classification of fireworks stores

Where more than one hazard division (HD) of fireworks is stored, use the highest hazard division classification to determine requirements, except for mixed storage of HD 1.2 and 1.3 fireworks, which must be treated as if it were a store containing HD 1.1 fireworks.

Compatible storage

Only fireworks that are compatible, including those of different hazard divisions, may be stored together.

1.1G, 1.2G, 1.3G and 1.4G fireworks are not compatible with:

- loose black powder;
- dangerous goods of Classes 2, 3, 4, 5, 6, 7, 8 and 9 (e.g. fuels, solvents, pool chemicals, and gas cylinders);
- fire risk substances; and
- combustible liquids.

Separation distances

Fireworks stores should be separated to minimise:

- communication of explosion between different stores; and
- harm to people or damage to property, whether or not this might be directly associated with the fireworks.

The minimum separation distances required for different types of explosives stores are given in Australian Standard AS 2187.1:1998 *Explosives – Storage, transport and use – Storage*.

Fire protection

Minimisation of fire risk

A person storing fireworks must ensure that the fire risk is minimised from within and outside the store by storing the fireworks:

- in a secured structure detached from any dwelling or shop unless specifically approved;
- with fire protection equipment and signs stating 'NO SMOKING' or 'KEEP FIRE AWAY' where the quantity exceeds those given in Table 5.1;
- keeping ignition sources to a minimum in the general vicinity; and

- not storing combustible equipment, including fireworks equipment (e.g. mortars, racks, set pieces), fuel powered machinery and vehicles, near fireworks magazines.

Fire protection equipment

A fire risk assessment should be conducted to determine the type of fire extinguishers to be used. Unless otherwise advised, the minimum fire protection equipment required is either:

- one 60B dry chemical powder (DCP) extinguisher; or
- one 2A water (nine litre) fire extinguisher.

Fire protection equipment must be readily accessible and serviceable.

Security

A person storing fireworks must:

- secure the fireworks to prevent access by unauthorised persons; and
- maintain a stock control system with records of damages and losses.

A security risk assessment must be undertaken to identify whether additional control measures are necessary. Security measures may include the store construction materials, locking mechanisms and shrouded covers over the padlock.

For vehicles, standard locking mechanisms are considered adequate.

Adverse weather conditions and spills

A person storing fireworks must ensure that:

- storage areas are dry and weatherproof;
- store is maintained in a clean and tidy state;
- no-one handles fireworks or is present in a fireworks store during a thunderstorm.

Placards

Three placard types are required for licensed fireworks stores.

HAZCHEM outer warning placards must be provided at entrances to the premises where emergency services gain entry. They must be positioned so they are clearly visible to the casual passer-by. HAZCHEM placarding specifications are given in Schedule 4 of the Dangerous Goods Safety (Storage and Handling of Non-explosives) Regulations 2007.

Store placards must be displayed on the magazine itself and doorways leading immediately to the magazine, and consist of an appropriate word such as 'FIREWORKS'. They should be positioned so they are not visible to the casual passer-by but clearly visible within the premises.

For fireworks quantities of more than 60 kg, a *Class 1 label* or '*diamond*' must be displayed on the magazine itself. It should be positioned so that it is not visible to the casual passer-by but clearly visible within the premises. The specifications for class labels are given in the Australian Explosives Code.

Storage placards must be maintained.

5.2 Temporary storage

A fireworks event permit holder may store fireworks at an unlicensed place if authorised by the permit. The authorisation will only cover fireworks used for the event.

Placarding with pictorial signs indicating no smoking and no ignition sources must be provided adjacent to the storage.

There must be appropriate physical or surveillance security.

The provision of vehicle placarding, shipping documents and separation distances complying with the Australian Explosives Code satisfies the requirements for temporary storage in vehicles at the event site. Fireworks must not be left unattended inside vehicles at the event site.

6 Transport of fireworks by road

6.1 Risk categories

The transport of explosives, including fireworks, is divided into three risk categories. As shown in Table 6.1, Categories 1, 2 and 3 refer to low, medium and high risk loads, respectively.

Table 6.1 Risk categories for transport of explosives

Hazard division	Quantity per vehicle (NEQ)		
	Category 1	Category 2	Category 3
HD 1.1	≤5 kg	>5–250 kg	>250 kg
HD 1.2	≤5 kg	>5–250 kg	>250 kg
HD 1.3	≤50 kg	>50–1,000 kg	>1,000 kg
HD 1.4 except 1.4S	≤250 kg	>250 kg	Not applicable
1.4S	Any quantity	Not applicable	Not applicable

Note: Table from Australian Explosives Code

6.2 Driver training requirements

Contractors and operators transporting Category 1 and 2 quantities for a fireworks event must be trained in:

- use of the types of fire extinguishers carried on the vehicle;
- required response when a fireworks incident occurs;
- areas where the fireworks cannot be safely transported; and
- transit storage requirements.

The driver must be able to supply documentary evidence of such training when requested.

There are explosives licensing requirements for the transport of Category 3 quantities of fireworks, and detailed information is available from the Resources Safety website.

6.3 Compatible loads

Only fireworks and other dangerous goods that are compatible may be transported together.

Classification of load

Where a load of fireworks contains mixed hazard divisions, the hazard division for the total load is determined by the highest hazard division, except for mixed transport of HD 1.2 and 1.3 fireworks, which must be treated as if it were HD 1.1 fireworks.

Packaging

With the exception of the 1.4S classification, fireworks must be transported in approved packaging or superior packaging that is correctly marked and labelled in accordance with the Australian Explosives Code. The superior package (such as a carry-box) must be of suitable design and construction.

Opened boxes of 1.4S fireworks do not require superior packaging for transport.

Separation from dangerous goods

Fireworks must be separated from incompatible dangerous goods, foodstuffs and fire risk substances for both storage and transport, with one exception — 1.4S fireworks may be transported with dangerous goods provided the amount of dangerous goods does not constitute a placard load.

6.4 Vehicle requirements

Vehicle standard and design

All vehicles transporting fireworks must comply with the Australian Explosives Code and be mechanically sound and clean. Those transporting placard loads (Category 2 and 3 quantities) must carry DCP fire extinguishers.

For vehicles carrying Category 3 quantities, the requirements include:

- fire screens;
- electrical wiring in conduit;
- a battery isolation switch; and
- insulation in the body (see note below).

Note: The body of the vehicle or a receptacle attached to the vehicle must be lined with wood or other material that provides equivalent non-sparking properties.

Placarding of road vehicles

All vehicles transporting Category 2 or 3 loads must be placarded.

Category 2 and 3 vehicles must be placarded front and rear with 250 mm Class labels appropriate to the highest classification and compatibility group of the fireworks. For example, if 1.1G, 1.3G and 1.4G fireworks are to be transported, the vehicle must be

placarded as 1.1G once the total quantity exceeds 5 kg NEQ. In addition, all four sides must be placarded with the word 'EXPLOSIVES' in red lettering 150 mm high on a white background.

For transport of fireworks with stowage over 1,000 kg NEQ (except HD 1.4), the placarding requirements are different. Such vehicles must be placarded at the front with a 250 mm class label and on all four sides with the the word 'EXPLOSIVES' in red lettering 150 mm high on a white background. In addition, the sides and rear must be placarded with 800 x 600 mm emergency information panels.

Placards need to be removed or obscured when a vehicle is no longer carrying fireworks.

Marking of freight containers

Freight containers carrying Category 2 or 3 loads must be marked on all four sides with class labels, in accordance with the Australian Explosives Code. Those carrying loads greater than 1,000 kg NEQ (except HD 1.4) require an emergency information panel on each of their longer sides.

Documentation

Any vehicle transporting fireworks must carry the following documentation:

- an emergency procedure guide for the fireworks being transported or a copy of the Standards Australia and Standards New Zealand Handbook SAA/SNZ HB 76: 2004 *Dangerous Goods – Initial Emergency Response Guide* (HB 76); and
- a shipping document identifying:
 - UN classification,
 - UN numbers,
 - shipping names,
 - number of packages,
 - quantity (NEQ),
 - types of fireworks, and
 - names of both the consignor and consignee.

6.5 Stowage and loading

Safe stowage and load security

Packages of fireworks and fireworks equipment must be stowed and secured on a vehicle in accordance with the current edition of the National Transport Commission's *Load Restraint Guide*. The friction and impact sensitivity of fireworks and any potential leaking composition from those fireworks must be considered.

Packages must be kept away from heavy articles or equipment likely to cause damage.

Packages of different shapes or containing different materials must be stowed to prevent their damaging one another.

The fireworks load must not project horizontally beyond the the vehicle.

Precautions during loading and unloading

Fireworks packages must not be dropped, thrown or otherwise mishandled during the loading or unloading of a road vehicle.

Fireworks must not be loaded or unloaded during thunderstorms.

Transport prohibitions

The carriage of reusable mortars loaded with aerial shells on public roads is strictly prohibited. This does not apply to ground level fireworks and barrages that are manufactured articles consisting of pre-loaded, single-use mortars as supplied by the manufacturer or supplier.

Passengers not directly assisting with the fireworks event are not permitted on a vehicle transporting fireworks, and vehicles containing fireworks must not be left unattended.

6.6 Procedural requirements

Control of ignition sources

Ignition sources must be controlled to prevent accidental ignition of fireworks, including:

- not smoking within a distance of six metres from any vehicle containing fireworks;
- not carrying matches and cigarette lighters in the vehicle unless they are in a sealed container in the glove-box; and
- not taking electronic equipment such as mobile phones, radio transmitters and pagers into the fireworks-carrying compartment.

Vehicle parking

The driver of a vehicle transporting fireworks, other than HD 1.4, should take all practicable steps to avoid close proximity to any other placarded explosives vehicle (except when overtaking or passing).

Except for stops necessary to comply with legal requirements or caused by vehicle breakdown, drivers of vehicles carrying a placard load, other than HD 1.4, should ensure that:

- vehicles do not remain stationary in a public place within a town or city;
- no temporary stops (less than one hour) are made within 100 metres of protected works, except for refuelling (see below);
- Category 3 loads are parked with battery isolation switches left open; and
- no stops for long periods (more than one hour) are made within ten metres of a road, street, source of ignition, railway, or within the distances listed in Table 6.2.

Table 6.2 Distances (in metres) between protected works and stationary road vehicles carrying Category 2 or 3 loads of explosives

Hazard division assigned to load	Quantity of explosives on vehicle (kg)						
	≤ 25	> 25 - 250	> 250 - 1,000	> 1,000 - 5,000	> 5,000 - 10,000	> 10,000 - 20,000	> 20,000 - 40,000
1.1	100	150	200	400	500	600	750
1.2	150	200	200	250	300	300	350
1.3	n/a	60	60	100	150	200	200
1.4	n/a	n/a	n/a	n/a	n/a	n/a	n/a

Vehicle refuelling

It is good practice to obtain fuel for the vehicle before it is loaded. If refuelling is required during a long journey then it must be:

- in a remote location;
- with the engine switched off;
- without any ignition sources within six metres of the vehicle;
- without mobile phones and radio transmitters being used; and
- when there is no thunderstorm activity.

Vehicle break down

The driver of a vehicle carrying a placard load that has broken down must alert other road users by:

- switching on the flashing hazard lights or, if there are no hazard lights, the parking lights, unless the battery has been disconnected to avoid danger; and
- placing double-sided reflector signals on the ground at right angles to the traffic flow:
 - between 50 and 150 metres in front of the vehicle,
 - between 50 and 150 metres behind the vehicle, and
 - beside the vehicle on the side facing the traffic.

The *owner* of the disabled vehicle must ensure that the vehicle is either:

- repaired to the extent that it may be removed safely from the road as soon as possible, and adequate precautions are taken during repairs to ensure the safety of the vehicle and fireworks on board; or
- towed in a safe manner to a place of repair as soon as possible.

Note: Before towing, consider moving the vehicle to a safe area and transferring the fireworks to another vehicle. The owner must advise the tow truck operator of the hazards associated with the fireworks on board the disabled vehicle.

7 Design, fabrication and maintenance of fireworks equipment

7.1 Safety considerations

The suppliers, designers, fabricators, owners and operators of fireworks event equipment are responsible for ensuring that it is properly designed, fabricated and maintained to minimise harm to people, including operators and their assistants.

Equipment must:

- not unnecessarily confine fireworks;
- be safe and suitable for use with specified fireworks (taking into account the effect of a catastrophic or extreme malfunction of the fireworks);
- be accompanied by manuals for the use and maintenance of equipment, including details of the types of fireworks that can be used with the equipment and the service life of the equipment; and
- be properly identified, including the identity of the fabricator.

The documentation must be updated with any information that becomes available after supply if it may impact on the safety of the equipment.

In addition to specific requirements for design identified in this code of practice, the designer must also meet the requirements of the *Occupational Safety and Health Act 1984* (the OSH Act).

7.2 Materials used

Acceptable materials

Equipment associated with a fireworks event (e.g. mortars, tubes, enclosed racks, stakes, pickets, stands) must be designed and manufactured from suitable materials, such as:

- paper wound tubes (cardboard);
- suitable plastic, high density polyethylene (HDPE), fibre reinforced plastic, glass reinforced plastic or fibreglass; and
- timber supports.

Polyvinyl chloride (PVC) equipment is prohibited because it is brittle and can fragment unacceptably during abnormal functioning of fireworks.

Metal may not be used for mortars, other than as exempted below, nor may clay or timber be used, other than for use in plugs, nor bamboo, ceramics, concrete, PVC or any other material that has brittle physical properties that can produce harmful fragments from an explosion (see Appendix 3).

Metal

The use of metal fireworks equipment is restricted because such equipment can produce lethal fragments when subjected to an explosion.

Mortars up to 300 mm in diameter must not be made of metal because they produce a serious fragmentation hazard and safer materials are available. If safe materials for mortars over 300 mm in diameter cannot be readily obtained, then such mortars may be made of metal conditional on:

- mortars being at least three-quarters buried (in skip-bins on barges) with a clearance of at least 400 m to spectators;
- mortars being positioned on a firm base and located no closer than a distance equal to the calibre of the largest shell to be used;
- mortars being previously tested for metal fatigue by non-destructive scanning; and
- approval of the Chief Officer.

In other applications, metal may be used where it has been established that it does not present an unacceptable risk (e.g. the metal is not close to the firework and an explosion would not produce harmful fragments). The designer, manufacturer and supplier must retain all necessary documentation to demonstrate the safety and suitability of the metal fireworks equipment for its intended application. The contractor must have completed a risk assessment for these situations. Such applications may include:

- metal star-pickets for defining barriers for crowd control;
- round steel rods with a diameter from 10 to 20 mm for securing fireworks or fireworks equipment for use at fireworks events (see note below) — the firework device may be attached directly to the round rod without spacers;
- trailers for holding fireworks items where the sides are constructed of wood or other non-metallic material (the frame of the sides may be made from metal such as light angle iron);
- trailers for the set up of fireworks events with metal sides but subject to the following conditions:
 - the trailer must be lined with at least 12 mm plywood,
 - all mortars and fireworks devices must be secured in relation to each other, and in relation to the trailer, and
 - salutes are not to be fired from metal trailers;
- nails, screws, staples, wire or strapping used to secure non-metallic items such as mortars, tubes, base plugs, racks and firing lines;
- round metal rods used to secure non-metallic items (e.g. cake boxes) into the ground to ensure stability and direction of the firework items contained within the box — these rods are to be securely hammered into the ground;
- steel posts and pickets used to support a set piece; and
- metal pegs driven fully into the ground used to secure mortar racks and frames.

Note: Flat metal, including angle iron and star-pickets, are not permitted for securing fireworks.

7.3 Mortars and racks

Responsible persons

The fabricator of mortars and any associated equipment is responsible for ensuring that the mortars and equipment are properly designed and tested.

It is the contractor's responsibility to ensure that mortars are inspected, maintained and fully serviceable.

The operator is responsible for ensuring mortars are inspected at events.

Design and construction of mortars

The manufacturer of mortars must prepare a TDS to be supplied with the mortars. The TDS must include information on:

- types of shells that may be fired from the mortar and limitations on use (e.g. charge weight of the lift charge of an aerial shell);
- requirements for care, maintenance and inspection;
- criteria for determining acceptance and suitability of mortars for safe use; and
- product life requirements (e.g. number of shells fired).

Mortars must be designed to safely fire mines and aerial shells to the height recommended by the supplier. The mortar design must be tested and certified by a competent person to ensure it is safe and suitable for its intended use and function.

The following should be considered:

- suitability of the construction materials;
- strength and durability of the mortar to safely fire the aerial shells to be used (see Appendix 8);
- expected malfunction from explosion or combustion pressure rise;
- length of the mortar to ensure that aerial shells are propelled to an altitude where the aerial shell breaks without endangering people or property (see Appendix 8); and
- intended use and limits for the design (e.g. maximum shell mass, charge weight and shell diameter).

Recognised explosives testing techniques should be used that consider:

- maximum charge weight of lift charge to be fired — an overcharge of 50% of the maximum lifting charge must be tested at a testing facility (consult Resources Safety regarding testing with additional lift charge);
- performance of the mortar for the worst case explosion for which the mortar will be used (e.g. a salute shell with the mass of a stated composition); and
- altitude and drift of shells for safety and performance.

Strength and durability

Mortars meeting the specifications of Tables A8.1 to A8.3 are acceptable. In some cases, a mortar can only be used a limited number of times before withdrawing it from service.

Length of mortars

Information on appropriate minimum mortar specifications is provided in Table A8.4.

Design of racks

Racks must be designed and constructed so that in the event of a catastrophic malfunction in a mortar, the risk of harm to people and property is reduced to an acceptable level. Such a malfunction must not impact adversely on the orientation, location and performance of the adjacent mortars, nor may it affect the performance of the adjacent fireworks within the rack. The overall integrity of the rack must be preserved and the rack design must not unnecessarily confine mortars containing aerial shells.

Plastic crates may be used as racks but the number of mortars per rack is limited (see Section 10.6).

7.4 Electrical firing units

A competent person must undertake the design, construction and certification of electrical firing units. Electrical firing units and accompanying junctions must be manufactured specifically for use in the electrical ignition of fireworks or other pyrotechnic devices.

An electrical firing unit with a built-in circuit tester must be designed to limit the test current to 50 mA or 20% of the no-fire current of the electric match being used, whichever is less. Multimeters, such as volt-ohm meters, must not be used for testing electric matches unless the maximum current delivery potential has been measured and meets these requirements.

Electrical firing units must be powered by batteries or isolated power supplies used for firing purposes only. If used, batteries must be self-contained in the firing unit or otherwise covered or protected to prevent accidental contact with wires leading to the fireworks. The electrical firing system should be shunted while loading fireworks.

Outdoor fireworks must not be fired using systems powered by mains power without prior approval of the Chief Officer. Mains power should only be used for the initiation of theatrical fireworks using pods.

In addition to the requirements listed here, the electrical firing units must be capable of providing a minimum electrical current of one ampere (1.0 A) through the maximum load (cable length and number of electric matches) recommended by the manufacturer.

Manual electrical firing units must include a key-operated switch or similar two-step device that greatly reduces the possibility of unauthorised or unintentional firings. Computer-based electrical firing systems must incorporate some form of a dead-man's switch so that all firings cease from the moment that the switch is released.

A handheld electrical firing unit must have two switches or require two actions for firing — one to arm the unit and the other to fire the unit — and be designed so it cannot be fired without first being armed. Switches used to apply power to electrical firing units for testing or firing must clearly indicate the function of each switch and should be protected from accidental firing. The unit must have a light or other indicator (or both) that signals when the unit is armed and ready to fire. Handheld firing units incorporating a capacitor discharge design must dissipate the stored charge within 15 seconds of the arming switch being released.

Remote firing systems must be approved by the Chief Officer. During an event, a person must be present at the transmitter end and another person at the receiver end at all times so that the remote signal can be manually interrupted at either end in an emergency.

8 Planning

8.1 Responsibilities

Event organiser

The event organiser should select a licensed fireworks contractor using a formal selection process.

Event organiser and contractor – shared responsibilities

The event organiser and contractor will need to agree on matters where they have joint responsibilities. To achieve this, meetings and regular communication between the event organiser, contractor, operator, relevant agencies and other concerned stakeholders should be held in advance of the event. Joint responsibilities include:

- selecting the fireworks;
- consulting with the local community near the fireworks event;
- determining the location for preparing the fireworks; and
- ensuring the provision of security measures for crowd control and control of access to the fireworks exclusion zone, including:
 - provision of security personnel;
 - creation of physical barriers;
 - ensuring the provision of first aid attendants;
 - emergency planning;
 - auditing and inspection of compliance and activities relating to the event;
 - effective supervision of operators and assistants; and
 - auditable control and security of fireworks.

Contractor

The responsibilities of the contractor at the planning stage should be detailed in the contractor's explosives management plan and include:

- ensuring the event organiser is aware of his or her responsibilities;
- ensuring the fireworks exclusion zone is suitable for the fireworks to be used;
- ensuring the fireworks event equipment is suitable and fully serviceable;
- ensuring the fireworks for the event are suitable;
- ensuring the local community is notified of the event;
- providing fireworks event insurance;
- selecting the operator;

- ensuring the operator is appropriately licensed and trained;
- ensuring the operator has been appropriately educated in the contractor's explosives management plan;
- ensuring all relevant agencies are notified and the necessary approvals obtained and event permit granted;
- ensuring that the operator has copies of any conditions and/or special permissions from any relevant agencies;
- identifying the site for the preparation and transit storage of fireworks;
- ensuring the provision of security measures according to the security plan;
- considering the provision of first aid attendants;
- ensuring the provision and use of appropriate PPE;
- providing a system for auditable control and security of fireworks;
- providing a system for effective supervision of the operator and assistants;
- ensuring that fireworks are used in accordance with the manufacturer's recommendations; and
- ensuring compliance with the Explosives Regulations and this code of practice.

Operator

The operator's responsibilities include:

- ensuring, at the time of the event, the fireworks exclusion zone is suitable for the fireworks to be fired and the equipment to be used;
- providing a system for the effective supervision of the operator's assistants;
- ensuring the fireworks for the event are suitable;
- identifying the site for preparation and transit storage of the fireworks;
- ensuring compliance with transport requirements for fireworks to the event;
- ensuring the equipment to be used is suitable, properly maintained, serviceable and safe;
- ensuring all required PPE is provided, available, serviceable and used;
- identifying the operator's assistants and ensuring that they are appropriately trained and instructed, and possess a security card if left unsupervised with fireworks;
- ensuring all fireworks are fully secured;
- ensuring the clearance distances to be used are suitable;
- ensuring all restrictions, conditions and special permissions from any relevant agencies are complied with;
- ensuring the exclusion zone is properly cleaned after the event; and
- ensuring compliance with the Explosives Regulations and this code of practice.

8.2 Event permit

Approvals process and monitoring

Local government and FESA must give prior approval for any proposed fireworks event and WA Police must be notified.

Other agencies that may be involved in the approvals process or monitoring of fireworks events include:

- AirServices Australia;
- Civil Aviation Safety Authority (CASA);
- Department of Environment and Conservation (DEC);
- Marine Safety Section, Department of Planning and Infrastructure (DPI);
- Parks and Conservation, DEC;
- State Emergency Service (SES), FESA;
- Swan River Trust, DEC;
- Volunteer Marine Rescue Services, FESA;
- WA Ambulance Service;
- Water and Rivers Commission, DEC; and
- WorkSafe, Department of Consumer and Employment Protection (DOCEP).

A contractor must gain permission from CASA before a fireworks event when at least one of the following occurs:

- fireworks are to be fired within 5.6 kilometres (3.0 nautical miles) of an airport, including airfields and helicopter landing pads; or
- fireworks effects will reach heights greater than 120 metres (400 feet) — generally applies to aerial shells 125 mm or more in diameter.

In addition, AirServices Australia provides air traffic separation services including the separation of firework display activity from aircraft operations in controlled airspace. This includes fireworks that could mislead an aircraft and hence endanger the safety of the aircraft.

All personnel involved in the conduct of outdoor fireworks events must take into consideration Department of Environment and Conservation requirements covering potential or actual environmental harm, including nuisance noise (see Section 8.6).

The Department of Environment and Conservation must be consulted when a fireworks event is planned in the vicinity of a state or national park. If the event is planned near a national park then National Parks and Wildlife should also be advised.

The Department of Planning and Infrastructure must be contacted for all events to be held on or over navigable waters.

The local Volunteer Marine Rescue Service must be notified when fireworks events are planned within one kilometre of the coast or other areas where watercraft may use distress signalling devices when in trouble. Perimeter patrols on the water during a fireworks event may be provided, and such monitoring should be discussed with the local unit.

At the request of the event organiser, contractor or operator, the SES may provide crowd control or other services. This should be discussed with the local SES unit.

The WA Ambulance Service is part of St John Ambulance Australia. At the request of the event organiser, ambulance or first aid services may be present at a large event.

All activities associated with a fireworks event, which is a workplace, are subject to the provisions of the OSH Act, which is administered by WorkSafe.

An event cannot proceed unless a fireworks permit is granted by Resources Safety. Further information, including the application form, is available from the Resources Safety website.

It is important to note that the event organiser, contractor and operator must obey a direction (e.g. a direction to stop an event) from a government official with statutory authority for that event, including a Police Officer, FESA Officer, or Dangerous Goods Officer from Resources Safety.

Permission of property owner and occupier

The contractor must ensure that permission has been obtained from the occupier and/or owner of suitable land before the event may proceed at that site. This is usually done through the event organiser.

If the property is not occupied by a responsible person, such as a park or vacant land, the event organiser must still seek the permission of the property owner. For example, local government will need to approve the use of a local park, reserve or beach.

Notification to local community

The contractor is responsible for effectively notifying, within a reasonable time before the event, those people who might be affected by the event. The number of people who may be affected will depend on the nature and size of the event, and the noise levels generated by the fireworks. Particular care must be taken in areas where noise may create a major problem with people (e.g. small children, elderly people) and animals (e.g. livestock, horses, pets).

The contractor must determine the size of the area for notifying the community (known as the community notification area) on the basis of expected noise and its affect on all people and domestic animals and wildlife in the neighbourhood.

The following must be considered when determining the size of the community notification area:

- size and type of fireworks to be used at the event;
- day, date, time and location of venue;
- locality (e.g. commercial, industrial, residential, rural–residential);
- special and vulnerable facilities;
- community facilities (including health care, aged care and places of assembly);
- domestic animals and wildlife (in shelters, refuges, sanctuaries, studs and domestic areas including stables, kennels, veterinary hospitals);
- terrain; and
- likely weather conditions.

As a minimum requirement for any proposed event, all neighbours up to 200 metres away must be notified. For larger events, the notification area will be larger. In certain circumstances, neighbours up to 800 metres away from the planned event may need to be notified. The event organiser must be satisfied that appropriate notification has been effected.

For established events such as the City of Perth Australia Day Fireworks, individual notification of the neighbouring community may not be necessary, provided there has been effective public advertising of the event.

The notification process must be effective. The most common practice is to include a written notice delivered to each property in the determined notification area at least four (4) days before the event. Notifications are normally undertaken by a letterbox drop. Notification may also include advertisements in the local paper, billboard posters and community radio. The notice must include the following particulars for the event:

- date and time;
- location;
- duration;
- brief description of the event and the effects;
- names of the contractor and event organiser; and
- name of a contact person (including phone contact details for the contractor and event organiser) for immediate provision of information.

In addition to formal notification of the local community, the event organiser and contractor must be available for consultation and discussion with the local community at reasonable times before and after the event.

8.3 Selection of fireworks

Contractors should be careful when selecting fireworks for an event. In particular, salutes or fireworks containing reports should be confined to large public events at a significant distance from sensitive and vulnerable locations, including residential or rural residential areas.

A maximum of three salutes per event is permitted, unless otherwise approved by Resources Safety.

The fireworks should be compatible with local conditions, taking into account:

- noise;
- features of adjacent areas such as nature reserves or community facilities (e.g. hospitals, homes, animals such as horses and dogs);
- prevalent environmental conditions (e.g. wind); and
- limitations of the proposed fireworks exclusion zone in conjunction with the event requested.

8.4 Selection of preparation site

The contractor and operator are responsible for determining the location for preparing the fireworks, which will depend on the circumstances and constraints imposed (see Section 5.1). Fireworks may be prepared in:

- the set up area;
- a controlled area (indoors or outdoors) at or near the set up area; or
- a workshop before being transported to the set up area.

When the fireworks are prepared in an outdoor location, the clearance distance must be at least the minimum clearance distance (see below) for the fireworks. If fireworks are prepared indoors in a workshop (or a building performing an equivalent function) then the site must be at least 30 metres from neighbours or other explosives storage.

8.5 Spectator exclusion zone

Protection of public and property from the discharge of fireworks

The operator must ensure that the point of launch of aerial shells ensures the safety and protection of the public and property (including dangerous goods stores, special and vulnerable facilities) from the discharge of fireworks (including fallout from hazardous debris, malfunctions and other associated hazards). Fireworks and mortars must be positioned so that any fireworks effect and hazardous debris (including an aerial shell that has not exploded in the air) falls within the fireworks exclusion zone, as calculated from the minimum clearance distance. The minimum clearance distances must be based upon the fireworks effects and hazardous debris at any height falling within the perimeter of the exclusion zone. Fireworks must not cross over or burst above any area occupied by spectators.

Suitability of fireworks exclusion zone

The suitability of the exclusion zone depends on assessing and determining an acceptable level of risk for the planned event and the circumstances that will be present during the event. The fireworks exclusion zone must have sufficient open space to meet the calculated minimum clearance distances. There should be no significant risk of harm to people or damage to property from fireworks. Nor should there be a significant risk of environmental harm or adverse environmental effects, such as nuisance noise.

The following issues must be considered when assessing the risk for the suitability of the site for the event:

- vegetation (including excessive numbers of trees and shrubs, dead undergrowth and dry grass), where it presents a fire risk and also obstructs the identification, location and recovery of dud aerial shells and other fireworks articles;
- areas where people and vehicles (including dwellings, buildings, temporary accommodation, vehicles and parking areas) will congregate;
- overhead obstructions, with respect to the firing area. Any overhead object or any part of an overhead object (e.g. trees, branches, wires, football posts, structures, buildings) must not be within ten metres of the set up area. The effects of wind, particularly tree branches swaying in the wind, must be taken into account to ensure that no obstruction is within the ten metre exclusion zone at any time;

- locality, size and area of the site, taking into account the type, nature and size of fireworks to be used;
- location of the actual event on the site, taking into account spectator locations and secured areas;
- weather conditions (such as wind) that will affect clearance distances required, including considering potential wind shift and change;
- time of the event (see Section 8.7);
- types of fireworks to be used (e.g. salutes);
- sensitive sites adjacent to the exclusion zone (such as rural or urban residences, health care facilities, aged care facilities, detention or correctional facilities, nature reserves, livestock properties and dangerous goods stores);
- ability for the operator and assistants to have a full view of the fireworks exclusion and firing zones; and
- number of events already held at that location.

Clearance distance

The minimum clearance distance is calculated to establish an exclusion zone around the fireworks at the event, and is generally determined from the firework requiring the largest clearance distance (see Section 8.6). The minimum clearance distance calculated should not be considered to be the optimum clearance distance. It is simply the minimum requirement based upon known conditions, estimations and assumptions to achieve acceptable risk.

The contractor (in the explosives management plan) and operator at the event site should aim for the spectator exclusion zone to significantly exceed the calculated minimum clearance distance to reduce the level of risk of harm to people and property as much as reasonably practicable. They should also allow for changes of conditions and incorrect estimations and assumptions leading up to and during the firing of the event. Information to estimate the calculated minimum clearance distance should be provided by the fireworks manufacturer or supplier in the TDS and incorporated into the contractor's explosives management plan.

The minimum clearance distances calculated apply to anyone not directly involved in the event, such as:

- performers, players and contestants;
- camera crews and photographers; and
- emergency services personnel.

The number of licensed personnel within the exclusion zone must be kept to a minimum to lower their exposure to risk.

Under certain circumstances other people involved with the event may be permitted within the exclusion zone for difficult sites when a risk assessment has been done and risk control measures implemented.

A typical fireworks exclusion zone is shown in Figure 8.1.

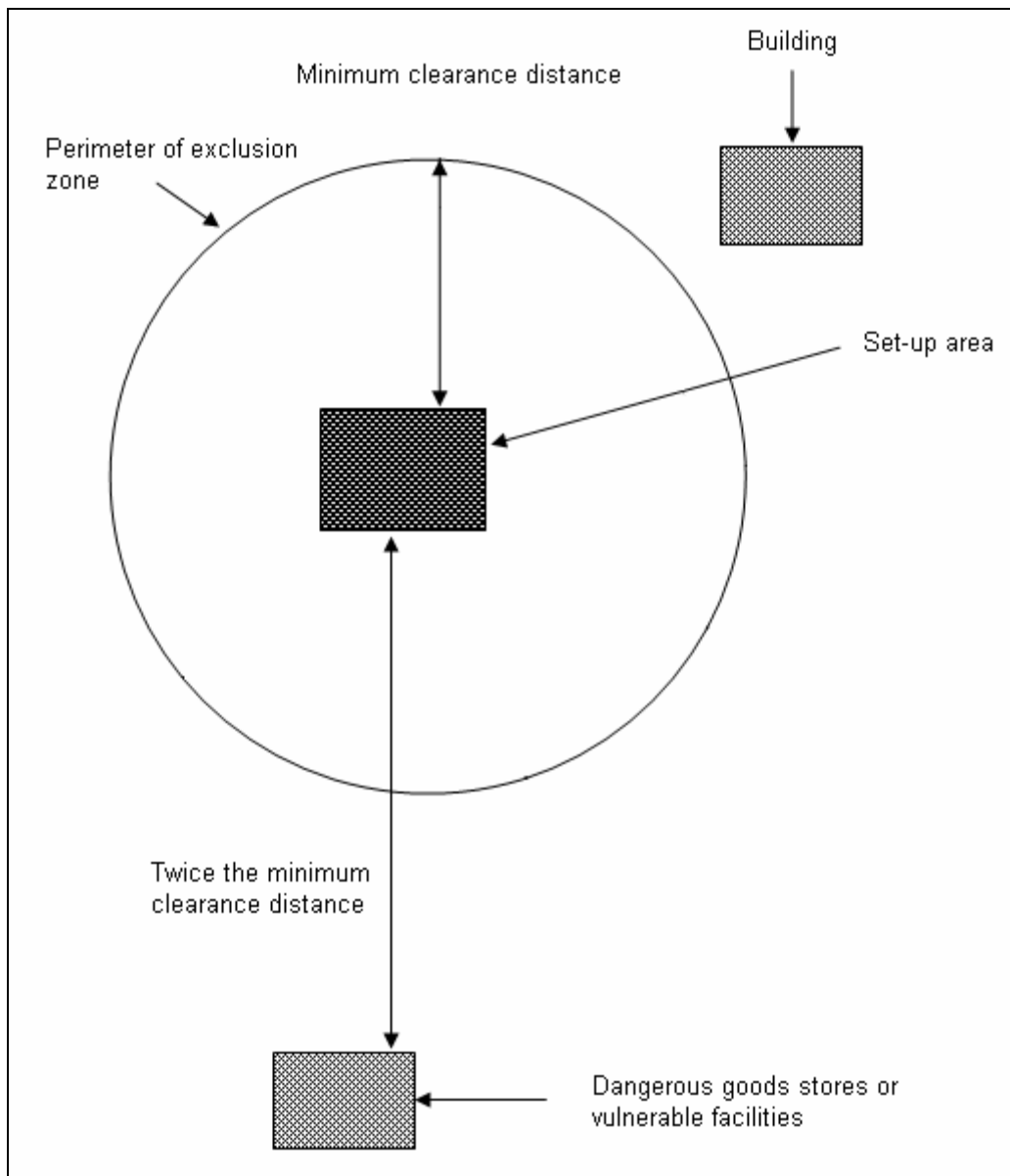


Figure 8.1 Typical fireworks exclusion zone

8.6 Calculating minimum clearance distance

Factors to be assessed when calculating the minimum clearance distance include:

- manufacturer's recommended minimum clearance distance;
- known effects and performance of the fireworks and any influences from equipment;
- effects of wind;
- effects of angled fireworks (e.g. aerial shells, candles) or sloping land at the set up area; and
- effects of fallout from hazardous debris.

The calculated distance applies to all fireworks in the event. In practice, the calculation of this distance is based on those fireworks having the maximum effect on the clearance

distance. For example, for 75 mm and 100 mm aerial shells to be fired from an area, the calculation would be based on the 100 mm aerial shells closest to the perimeter of the exclusion zone. The calculations for 75 mm shells could be redundant unless their angle was significantly different or some other factor gave a much wider spread of the fireworks effect or fallout.

The clearance distance for theatrical fireworks to be fired closer to the perimeter of the exclusion zone may be calculated separately.

The minimum clearance distances under ideal conditions for all fireworks are presented in Tables 8.1 and 8.2. These distances are based on zero wind speed and on the true vertical firing of all fireworks. However, factors such as variations and tolerances mean that all fireworks effects fired and propelled will have a random scatter effect and will not have a truly vertical trajectory.

The manufacturer must also recommend a minimum clearance distance in the TDS for the firework supplied. If the manufacturer's recommended minimum clearance distances differ from the minimum clearance distances in Tables 8.1 and 8.2, the greater of the two minimum clearance distances must be used.

Table 8.1 Minimum clearance distances for ground fireworks

Ground fireworks	Minimum clearance distance
Lancework only	15 m
Lancework incorporating fountains	30 m
Fountains, revolving fountains and flares	30 m
Mine bags, multishot box items, Roman candles, comets, mines	45 m

Table 8.2 Minimum clearance distances for aerial fireworks

Size of aerial shell	Minimum clearance distance
Up to and including 75 mm	45 m
100 mm	75 m
125 mm	100 m
150 mm	150 m
200 mm	200 m
250 mm	250 m
300 mm	300 m
Over 300 mm	As required by the Chief Officer

Note: Based on operator experience, aerial fireworks may be moved in the upwind direction by up to ten metres to mitigate local wind conditions — this may be considered along with reducing shell sizes and other appropriate action.

Effects of wind

The supplier of the fireworks should provide information on the effects of wind drift on fireworks performance. In windy conditions, the clearance distances used with aerial shells should be increased on the downwind side of the exclusion zone by the distances given in Table 8.3. The event organiser should be advised in advance regarding possible allowances for wind to arrange for some flexibility in the running of the event. If the wind speed is more than 50 km/h then the event must not proceed.

The minimum clearance distance for all fireworks firing effects higher than 15 metres vertically must be taken into account for the final calculation of clearance distance.

Table 8.3 Typical aerial shell drift in windy conditions

Wind speed	Description	Shell drift (shell diameter)		
		75 mm	150 mm	300 mm
Light breeze 8 km/h (5 mph)	Wind felt on face; leaves rustle; ordinary vane moved by wind	15 m	16 m	17 m
Gentle breeze 16 km/h (10 mph)	Leaves in constant motion; wind extends light flags	30 m	32 m	34 m
Moderate breeze 24 km/h (15 mph)	Raises dust and paper; small branches move	45 m	48 m	52 m
Fresh breeze 32 km/h (20 mph)	Small leafy trees sway; crested waves form on inland waters	60 m	65 m	69 m
Strong breeze 40 km/h (25 mph)	Large branches move; wires whistle; umbrellas difficult to use	75 m	81 m	87 m

For some central arena events, angling is not an option and fireworks must be fired vertically. Aerial fireworks may be launched slightly upwind from the centre of the exclusion zone to negate the effects of wind, but this will reduce the clearance distance to spectators in the upwind direction. The upwind adjustment distance is difficult to prescribe and should be based on the operator's experience, allowing for local wind conditions at the time. If the reduced clearance distance in the upwind direction compromises the minimum clearance distance for upwind spectators then, as a last resort after reducing shell sizes or taking other appropriate action, the minimum clearance distance in the upwind direction may be reduced by a distance no greater than ten metres.

The effect that wind may have on the exclusion zone is illustrated in Figure 8.2. The contribution of wind effects on the calculated clearance distance should be calculated separately and in addition to the estimations for the exclusion zone from the fallout of hazardous debris. The operator must have accurate estimates of wind conditions to ensure the effectiveness of the calculated minimum clearance distance.

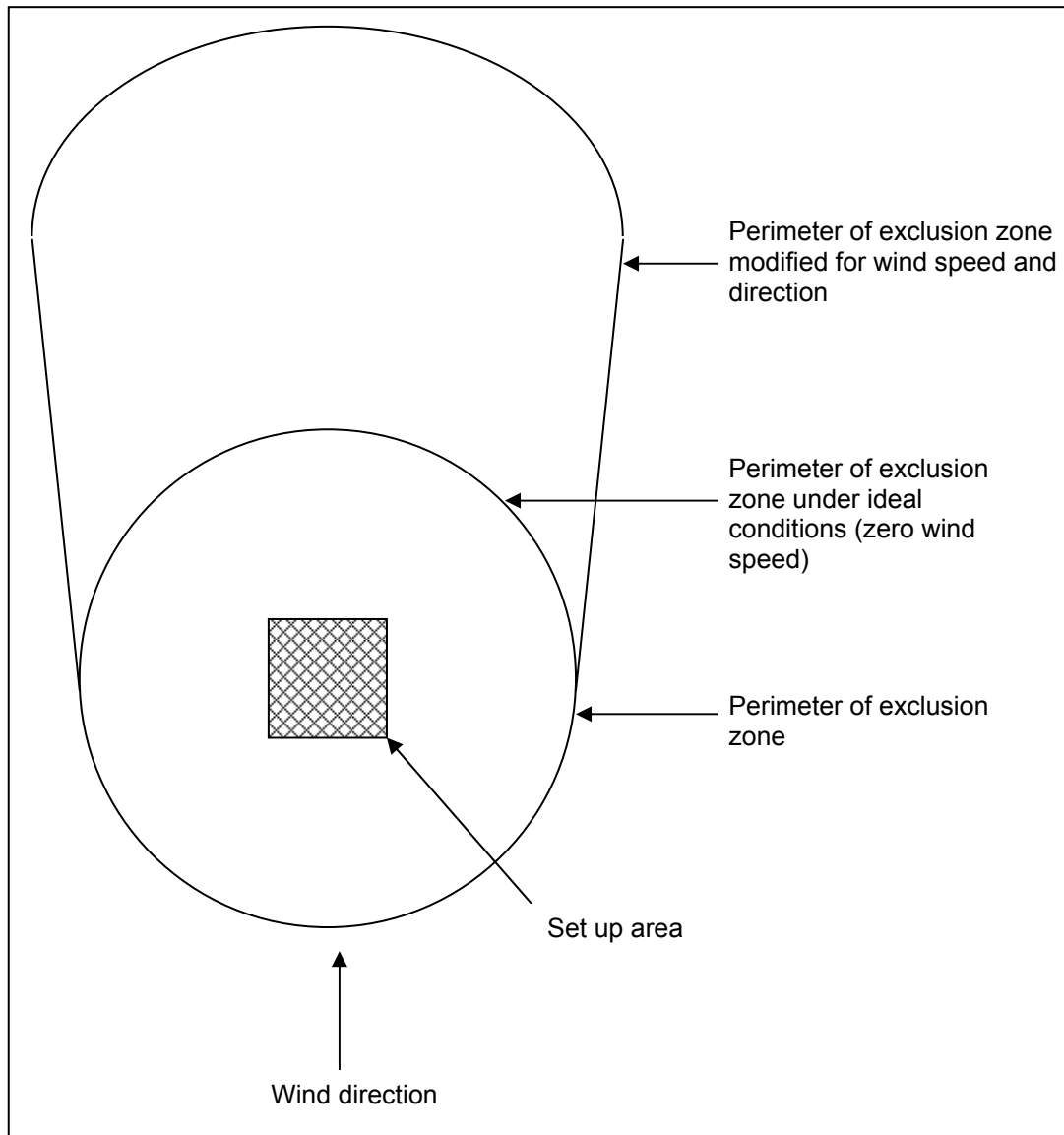


Figure 8.2 Effect of wind on exclusion zone

Effects of angled fireworks

From a safety point of view, it is preferable to keep all fireworks vertical but, for aesthetic reasons, many operators position fireworks at an angle to produce cross-over or other effects. For example, many boxed items are supplied fanned so the clearance distances must consider the angle of the angled tubes for the calculation of the minimum clearance distance.

When angling occurs, the minimum clearance distance becomes ineffective because a malfunctioning firework will land closer to spectators than if it was fired vertically. Accordingly, if any types of fireworks are angled, the angle must be determined and the minimum clearance distance recalculated.

As a general rule, an aerial shell will reach a vertical height of 30 metres per 25 mm of shell diameter (100 feet per inch of shell diameter). This varies with the amount of lifting

charge, mortar length, angle of launch and so forth. The tables in Appendix 9 demonstrate the effect that the launch angle from the vertical has on the distance various shells will move horizontally (range) for a number of wind speeds. Tables A9.1 to A9.4 are based on a shell being a dud and the range being estimated for the shell returning to the ground unexploded. The contribution from natural shell drift is not included.

Mortars may be angled intentionally during an event to negate the effects of wind and carry dud shells away from the spectator viewing areas. Fireworks must not be angled towards spectators to negate wind on the basis of adjusting the minimum clearance distances. Fireworks should only be angled upwind provided this is away from spectators or buildings. The clearance distance cannot be reduced should the firework be angled away from the crowd because the clearance distance is calculated from the point of launch of the firework.

The point of launch of the fireworks may be a trade-off between the angling of the fireworks and the effects of the wind. Operators must be cautious because a wind shift can amplify the flight distance of a firework if the wind blows in the same direction as the firework is angled.

Mortars that are not aligned exactly vertically will also have significant effects on shell drift and the clearance distances necessary to ensure a safe event. For example, a two degree tilt (representing a tilt of about 10 mm at the top of a 300 mm long mortar) can send a 75 mm shell about 13 metres down-range. It is not uncommon for a mortar rack to produce this level of movement. Furthermore, the land at the event site may not be level and operators should check the angle of secured fireworks from true vertical using a plumb-line if necessary.

Effects of fallout from hazardous debris on exclusion zone

The fallout area must be a large open area within the exclusion zone bounded by the calculated minimum clearance distance. Hazardous debris including debris from small components and the casings should not land outside the exclusion zone. Spectators, parking areas, unauthorised vehicles including watercraft, premises, sensitive and vulnerable facilities and readily combustible materials must not be located within the fallout area for hazardous debris during the event.

The minimum clearance distance for the fallout area from hazardous debris must account for wind speed, wind direction and changes in wind direction, and the type and performance of fireworks being fired. For stronger winds, the clearance distances downwind should be much larger than the clearance distances across wind and upwind.

The crowd and other significant exposures should not be located downwind unless there are large areas available for the exclusion zone. The wind speed at the height at which the fireworks function (e.g. aerial shells) should be considered, rather than ground level wind speeds. Exposure downwind is always a major concern.

Increasing calculated minimum clearance distance

Potential impact on sensitive and vulnerable facilities

For safety reasons, the minimum clearance distance from sensitive and vulnerable facilities (e.g. health care facilities) and the point of launch must be at least double the calculated minimum clearance. These distances may need to be increased if noise is an issue.

Dangerous goods present a risk of explosion, fire or toxicity. Dangerous goods locations include premises that are placarded for dangerous goods and service stations. The minimum clearance distance between packaged dangerous goods locations and the point of launch of the firework must be at least double the calculated minimum clearance

distances. The minimum clearance distance for bulk dangerous goods locations must be at least double the calculated minimum clearance distances or 250 m, whichever is greater.

The fuel tanks on vehicles or other motorised equipment located in the exclusion zone are not taken into the calculation of minimum clearance distance, provided that they have been fully protected from the effects of a malfunctioning firework as determined by risk assessment.

Outdoor theatrical events

Outdoor theatrical events use theatrical fireworks and the minimum clearance is three metres. However, the clearance may have to be increased to meet:

- manufacturer's instructions;
- angled fireworks; and
- weather conditions.

As for outdoor fireworks, the calculation of minimum clearance distances for theatrical fireworks used outdoors will need to be adjusted due the effects such as wind and angling. If outdoor audiences are permitted to smoke then the minimum distance for theatrical fireworks becomes five metres or the manufacturer's recommendation, whichever is greater.

If the operator is not licensed for theatrical events, a licensed theatrical operator must be subcontracted.

Reducing calculated minimum clearance distance

Engineering solutions, such as the adoption of effective barriers and shields, may mitigate the impacts, effects and consequences of malfunctioning fireworks. The largest, potentially most dangerous fireworks would benefit from the application of engineering solutions. If the effectiveness of the engineering solution can be demonstrated to the satisfaction of the Chief Officer to reduce the minimum clearance distance for the fireworks, the calculation of minimum clearance distance may be changed.

8.7 Noise issues

Noise generated by fireworks events can be a concern to the community. Event organisers, local government, contractors and operators need to consider the effect of timing and impact of noise on the local community. People responsible for operating an event must adopt all reasonable and practicable measures available to minimise noise impacts on the local community. Communication with all parties affected by noise is vital.

Fireworks events are considered 'exempt noise' under the Environmental Protection (Noise) Regulations 1997, and the Department of Environment and Conservation is rarely involved with this issue. Noise is an issue that needs to be dealt with at the local level.

The approval process for the fireworks event ensures that its location, date and time are acknowledged by local government. The operator is then responsible for adhering to the event time and any conditions prescribed by local government.

Resources Safety recommends that events start and finish within the following hours:

- Sunday to Thursday – 8.00 am to 9.00 pm
- Friday and Saturday – 8.00 am to 10.00 pm

Sometimes the exact firing timing cannot be anticipated, and under such circumstances a time range should be given (e.g. between 8.00 and 8.30 p.m.).

Written consent from the Chief Executive Officer (CEO) — or a formal delegate of the CEO — of the relevant local government is required to obtain a permit for a fireworks event outside these preferred hours. The CEO may give conditional permission where necessary.

For events outside the preferred hours, the event organiser is responsible for arranging a thorough notification of neighbours living in the vicinity prior to the event. Notice of the event is generally given to locals through advertising or a letter drop. Community expectations need to be considered. For example, an event on a Saturday night may not annoy locals but the same event on a Sunday night will. In rural and semi-rural areas, special consideration must be given to livestock.

The operator can reduce noise by using distance, shielding and excluding loud items. Sometimes the natural lie of the land can be used to reduce noise, especially for ground fireworks. Weather conditions must also be considered. For example, sound travels more efficiently on a cold still night so consideration should be given to dropping loud items from the event. Firing fewer items or reducing the firing rate can also be effective options. Salutes must not be used in situations where noise is an issue.

A clearance distance of at least 250 metres applies to noise sensitive areas such as health care facilities and animal shelters. Where this is not possible, the appropriate people must be notified in advance. If agreement cannot be reached, the contractor should refer the matter to the event organiser. In addition to the 250 metres clearance mentioned above, managers of all other sensitive facilities within 500 m, and further if appropriate, should be notified.

The problem of noise is an ongoing issue, and the operator is responsible for managing noise in a professional manner. Communication with all parties affected by noise is paramount. Often people are more upset because of the lack of notification rather than the noise itself.

8.8 Extraneous electricity

Sources

Extraneous electricity results from natural and man-made situations.

Lightning

Lightning is a potential high-energy source capable of initiating fireworks. The situation may be aggravated if there are conductors near the lightning discharge point that leads to the site (e.g. conductive ore body, water pipes).

Induced currents and capacitive discharge

Induced currents may be present in areas such as around power stations and earth loop transport systems (e.g. rail). Capacitive discharge may occur where high voltage transmission lines charge a suspended, aboveground electric circuit to a high voltage. This voltage may then be discharged to earth through an electric match thus causing a premature initiation of the fireworks.

Accidental earthing

Should there be an accidental earthing of a power transmission line near an electric circuit, fireworks may be prematurely initiated.

Transmitters

When using electric initiation, there is a possibility of the electric circuit being energised by the electric field produced by radio transmitters, radar, television transmitters or the like.

Static electricity

While electrostatic charges are among the most common phenomena in nature and the mechanism of the formation of the charges is controversial, the potential for an electrostatic charge to initiate an electric match or black powder is very real. For a dangerous condition to exist, three criteria have to be met:

- a capacitor-like object needs to be charged to a potential (voltage) such that the electrical energy stored in this system is large enough to cause initiation when released as a discharge (e.g. the capacitor can be a person or fireworks equipment);
- the capacitor has to lose its charge to cause ignition; and
- the path of this discharge needs to be sufficiently close to the sensitive material to cause ignition or initiation.

Note: The first point above offers the best potential for introducing preventive measures and thus minimising an electrostatic charge build-up.

General preventive measures

The possibility of premature initiation from extraneous electricity is always a potential hazard. Where extraneous electricity is suspected or evident, detailed information should be sought from the manufacturers as to the suitability of their products and initiation systems. Some preventive measures applicable to all initiation systems are:

- use a non-electric initiation system;
- ensure all bare connectors in a circuit are kept shorted out by twisting the ends together until final connection;
- avoid situations that may generate and store static electricity;
- take special care to ensure bare lead wires do not come into contact with the ground and connections are either insulated or kept clear of the ground;
- cease all set up operations if an electrical storm is imminent; and
- keep electric matches clear of the ground until set up commences.

Specific recommendations are provided below.

Stray currents

Under certain conditions, stray electrical currents can prematurely initiate fireworks.

Tests for stray currents should be carried out in advance of electric firing, particularly in highly conductive ground or where continuous metal objects extend into the fireworks exclusion zone. A suitable test is given below. As the minimum firing current for electric matches is 250 mA, the tests should be sensitive to at least 60 mA (AC or DC).

Test for stray currents

A high impedance (10 M Ω or more) voltmeter should be used to test for stray currents. Two probes made of identical material 25 mm in diameter and 200 mm long should be

driven into the ground or placed between the locations being tested (e.g. damp spots, pipes, rails). Stainless steel is recommended for probes.

As any source of potential can be dangerous (whether caused by stray currents or something else), it is advisable to try to locate the greater potential difference within a one to two metre radius from the point where the electric match leads are likely to be placed.

Once the highest potential difference has been found, a low-impedance ammeter (1 Ω or less) should be placed across the probes and the current recorded. If the current is less than or equal to 60 mA, the situation is reasonably safe. If the current is more than 60 mA, special precautions should be taken to ensure the bare lead wires cannot come in contact with the ground. Where possible, all stray currents found should be eliminated.

It is advisable to test for stray currents over a period of time in order to be aware of fluctuations that may become more pronounced when heavy equipment is started or operated near the test area.

Electromagnetic radiation

Safe distances for electric matches subject to radio frequency radiation

Where electric matches are used to initiate fireworks charges, they must be used at such distances from sources of electromagnetic radiation that a substantial factor of safety is provided against the possibility of induced ignition of the matches from these sources.

Appendix 10, which has been extracted from British Standard BS 6657:1991 *Guide to protection against ignition and detonation initiated by radio-frequency radiation*, sets out recommendations for safe distances from electromagnetic radiation when electric matches are being used to initiate fireworks. These distances may not apply under desert and marine conditions where special firing methods may give rise to an increased hazard.

Atmospheric electrical activity

If there is evidence of any form of atmospheric electrical activity or disturbance, the set up at the event site must be suspended and operations not be resumed until the electrical disturbance has passed.

Direct contact with electrical conductors

Where firing cables or wires are used near power or lighting cables, adequate precautions must be taken to prevent any firing cables or wires from coming into contact with electrical conductors before, during, or after the event.

Induced currents and stray currents

Adequate precautions must be taken to prevent initiation of fireworks due to capacitive and inductive coupling from high voltage lines, and from stray currents.

Note: As a guide, electric firing should not be used within 100 metres of power lines with voltages in excess of 20,000 V.

Static

Adequate precautions must be taken to prevent initiation of fireworks due to the build-up of static electric charges. The following situations can contribute to this hazard:

- not wearing clothing made from natural fibres;
- moving plastic sheeting;
- loading dry sand into bins;

- pouring fireworks powders or compositions; and
- dust storms.

In dry and dusty conditions, the accumulation of static charges may be substantial during dust storms. Certain precautions should be observed if work must be done under these conditions. The recommended procedure to be adopted is:

- lay out the electric firing cable;
- short-circuit both ends and connect both to earth, such as by driving a metal rod into the ground, and wetting the ground if it is very dry;
- short the electric match leading wires and attach their ends to earth;
- uncoil the leading wires carefully and lay them along the ground — the wires must not be thrown and, in uncoiling, the operator should handle the portion of the wire adjacent to the electric match, not the match itself;
- operator should be earthed before handling the electric match prior to connection to the firework, to prevent possible sparking from match head to firework;
- disconnect the leading wires from the earthed rod and connect them to the leads of the electric firing cable, which should also have been disconnected from earth;
- do not disconnect the other end of the cable from earth until ready to fire; and
- when operating near electric power lines, make sure the leading wires and electric firing cable are securely anchored and placed so they cannot be made to contact the power lines by the elevation of the fireworks.

Other static electric hazards

The following precautions should be taken to deal with other static electric hazards:

- all machinery near the fireworks exclusion zone should, where possible, be well earthed;
- the wiring of the electric firing circuit should be separated from large conductors such as rails or piping and be protected and isolated with good insulation; and
- care should be taken when covering fireworks with plastic sheeting (e.g. to protect the fireworks), and when removing such sheeting. People should be clear of the fireworks when carrying out such activities.

8.9 Bush fire prevention

FESA is the umbrella organisation with overall responsibility for the following bush fire related agencies:

- Bush Fire Service;
- Fire and Rescue Service (career);
- Fire and Rescue Service (volunteer); and
- Emergency Management Services.

Bush fire emergency

Fireworks are banned when a bush fire emergency period has been declared for an area by the Minister for Police and Emergency Services.

Restricted and prohibited burning times

With the exception of a declared bush fire emergency period, restricted and prohibited burning times do not specifically prohibit fireworks events. However, restrictions and conditions will apply as prescribed on the event permit application form.

FESA officers may take action to prevent an event from proceeding. However, it is expected that the decision to not proceed with an event would be arrived at by consultation and agreement with the contractor and event organiser, before the need for direct action by FESA.

For events during restricted and prohibited burning times, the operator must ensure that a fire fighting vehicle with two operatives. The vehicle operators must be equipped with appropriate PPE and have completed FESA's introductory fire fighting training (or an equivalent).

The fire fighting vehicle must:

- have a water carrying capacity of at least 500 litres;
- be fitted with at least 20 metres of 19 mm diameter rubber hose;
- have a pump capable of delivering 120 litres of water per minute at 700 kPA through an adjustable nozzle having a full spray pattern capable of projecting a six metre jet of water; and
- be capable of being driven over the terrain where the event is held.

The relevant local government chief bush fire control officer or FESA fire services manager may provide an exemption from the above fire fighting appliance requirements for the purposes of the event. Note that this exemption is not applicable on very high or extreme fire danger days (as forecast by the Bureau of Meteorology).

In addition to the above, on days when a very high fire danger exists, only the following fireworks are permitted:

- ground fireworks and aerial shells discharged over water; or
- ground fireworks and aerial shells discharged in areas that are urban having a negligible building or bush fire risk and with sufficient fire fighting resources being made available as agreed to by the relevant chief bush fire control officer or fire services manager.

On days when the fire danger for the area is extreme, only the following fireworks are permitted:

- ground fireworks and aerial shells discharged over water from barges; or
- ground fireworks but not aerial shells in areas that are urban and have a negligible building or bush fire risk, and with sufficient fire fighting resources being made available as agreed to by the relevant chief bush fire control officer or fire services manager.

Furthermore, on days when the fire danger for the area is very high or extreme, the operator must advise one of the following that the event is going ahead and it will be complying with conditions:

- FESA communications centre (ph. 9323 9333) for events within the metropolitan area;
- local government chief bush fire control officer for events in regional areas, excluding townsites covered by the Fire and Rescue Service; or
- local FESA fire services manager for regional townsites covered by the Fire and Rescue Service.

Note: Should any unplanned fire occur during the event, the fireworks operator must call 000 as soon as possible.

Urban bushland

Coastal and urban bushland reserves commonly support remnant populations of native flora and fauna. Such areas are valued by local communities and organised groups are often involved with rehabilitation projects. As a result, urban bushland reserves are considered environmentally sensitive. Care needs to be taken to protect fauna from excessive noise and extra precautions must be taken to prevent bush fires.

8.10 Record keeping

The contractor and operator are required to maintain records of all events as detailed in the contractor's explosives management plan. A copy of the event permit and the fireworks industry worksheet are regarded as being adequate records of the event. The contractor must also maintain stock keeping records of fireworks, which will help identify any shortfall or theft. These records should be maintained for at least three years.

Alternatively, the contractor and operator may keep a logbook as an alternative to the fireworks industry worksheet listed above. The logbook should contain the following information:

- location, date and time of the event;
- quantities and types of fireworks to be used;
- details of misfires and malfunctions and the method of disposal of faulty fireworks;
- operator's signature;
- names of the operator's assistants;
- weather conditions;
- any unusual incidents (including people trespassing in the exclusion zone);
- any complaints received; and
- other relevant details.

The records must be made available to a dangerous goods officer on demand. They may also be inspected and audited. A copy may be requested by Resources Safety for evidence of experience for upgrading licences or removing restrictions.

9 Workshop operations

9.1 Fusing operations

Electric fusing operations

Fireworks are fused by inserting the electric match into the quickmatch fuse and securing it in position with tape or twine. Electric match wires must always be kept shunted until final hook-up at the set up area.

Any operation involving the attachment, removal, or repair of an electric match must be carried out:

- in a dedicated area (either at the event site or offsite in the contractor's or operator's workshop); and
- remote from people, protected works, storages of fireworks (including magazines) and other features that represent an unacceptable risk should the fireworks accidentally ignite.

Match heads are easily ignited and are sensitive to many stimuli, such as friction. Great care must be taken when fitting and removing electric matches from fireworks. Never pull electric matches out of a quickmatch. Instead, cut the quickmatch with approved cutters. Match heads must not be crushed when cutting the fuse to remove them.

The quantity of fireworks being worked on at any one time must be minimised. Cartons of fireworks must be kept outside the workroom and fused fireworks frequently removed from the room.

Direct fusing into the lift charge of aerial shells is prohibited. If mortars secured by rack systems are being used to support aerial shell mortars, the shells should be fused in such a way that shells are fired progressively from the outside to the inside of the array of mortars. This will reduce the overall consequences if a shell malfunctions in an individual mortar.

Repairing fuses

A competent person may perform minor repairs to fuses (e.g. repairing torn paper and fitting replacement electric matches) provided the pyrotechnic composition has not been lost and the performance and safety of the firework will not be compromised.

Cutting fuses

Cutting tools, such as scissors, pliers and side-cutters, must not be used to cut fuses. Such tools have been known to ignite quickmatch because of the pinching or shearing action on powder grains. Instead, fuse may be safely cut using:

- a sharp knife on a wooden or other non-sparking surface; or
- garden cutters of the blade and anvil type or similar (where the blade cuts against a flat surface or anvil made from plastic, brass or other non-sparking material).

Manual firing of aerial shells

Safety caps protecting fuses must not be removed until immediately before the aerial shells, or rows of aerial shells, are to be fired.

9.2 Mortars

Terminology

The terms used to describe grouped mortars and racks of mortars in this code of practice are illustrated in Figure 9.1.

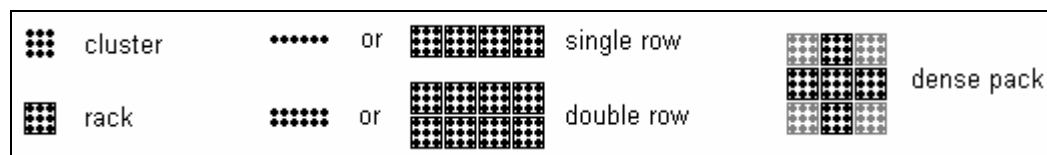


Figure 9.1 Grouped mortars

Note: A dense pack is one rack or more surrounded on all four sides by other racks.

Condition

Mortars must only be used in accordance with the manufacturer's recommendations and stated design, testing and performance criteria. Their age and serviceability must be readily identifiable.

Information on assessing their condition, suitability and serviceability must be provided by the supplier of the mortars.

Inspection

To ensure that mortars used to launch aerial shells are maintained in safe functional condition, each mortar must be carefully inspected, before an event, for:

- visible defects (e.g. bent or curved, dents, bent ends, damaged interior surfaces, splits, damaged plugs, attachment of plug to mortar and water damage);
- the presence of foreign materials; and
- unexploded aerial shells and components of aerial shells.

Damaged or defective mortars must be tagged as 'REJECTED' or 'UNSAFE FOR USE'. If they cannot be repaired, they must be disposed of or destroyed as soon as practicable. Cardboard mortars that have sustained undetected damage to their interiors may result in serious malfunctions during firing.

Size

The size of mortars is measured by their internal diameter. Because the pressure safety margins generally decrease with increasing mortar size, mortars may be restricted by size. For example, cardboard mortars must not exceed 200 mm. There are also

restrictions on the number of mortars of a specified size that may be grouped (see below).

Support, protection and securing of mortars

Protection and support for mortars are essential to prevent any injury to people or damage to property from failure of a mortar tube, aerial shell misfire, premature explosion of an aerial shell, projection of debris or inadequate discharge of an aerial shell.

Mortars must be supported, braced, or secured regardless of the location in such a way as to:

- remain in position when fired;
- be protected or separated from one another; and
- ensure neighbouring mortars are not damaged or realigned due to a malfunctioning aerial shell exploding in the mortar.

The systems used to support, protect and secure mortars and fireworks must perform satisfactorily during normal or abnormal functioning of the fireworks. They include:

- securing mortars to stakes or posts;
- partial burial of mortars in the ground or a sand-filled bin to an appropriate depth with some form of moisture protection (e.g. plastic bag);
- placement of sandbags around mortars to an appropriate height;
- placement of mortars in wooden troughs with internal bulkheads, as necessary, to support the trough, and with sand or other suitable filling to support the mortars;
- placement of mortars in plastic drums with wood blocking to support and separate the mortars as appropriate, or use other suitable filling to support the mortars (e.g. sand);
- placement of mortars behind a barrier or wall shown by witnessed tests to be resistant to fragments generated by explosion of the aerial shell and rupture of the mortar; and
- support for mortars or mortar racks, troughs or drums to ensure mortars are not realigned.

The misalignment or dislodgement of a mortar may render the subsequent firing of the shell unsafe or cause the shell in an adjacent mortar to sympathetically explode or perform unsafely. The use of sand, including sandbagging, is strongly recommended for all applications involving mortars.

Sandbagging should be regarded as providing a method of protection and not as a method of adequately securing the mortars. Sandbags used for protection from the mortar should be located at a minimum of one diameter distance away from the mortar to prevent additional high-energy missiles resulting from a malfunction.

The fragments of a rack system become dangerous debris with the potential to cause injury or to reposition other mortars and racks in the area. Therefore, the size and number of mortars permitted on a rack system may be restricted to reduce the possibility of damage to the rack system. To prevent racks tipping over, they should be secured by attaching stakes or spikes driven into the ground, banding or using other equivalent means.

General limitations on numbers of mortars per rack

Rack limit

The number of mortars per rack for firing standard aerial shells (1.3G classification) is limited according to Table 9.1. Mortars over 150 mm internal diameter cannot be racked because the explosive forces become too great.

Note: The rack limits do not apply to barges or floating platforms where the clearance to spectators is at least 400 m.

Table 9.1 Rack limits based on mortar size for firing standard shells

Internal mortar diameter	No. of mortars per rack
75 mm	12
100 mm	10
125 mm	5
150 mm	5
Over 150 mm	Not allowed

Note: Mortars firing perchlorate based aerial shells or salutes (1.1G classification) have additional restrictions placed on them that take precedence over this table.

Multishot boxed items

Since some multishot boxed items may have over 100 tubes per box, they must only be fired in single or double rows. Dense packing of multishot boxed items is not permitted because the risk of overheating and knock-on is unacceptable (e.g. dense packing of nine 25-shot boxed items involves at least 225 tubes and heat loading is too great).

Securing mortars by trailer-mounted rack systems

Mortars no greater than 150 mm in diameter may be fixed to racks mounted on a trailer. The trailer for a rack system must be:

- of sufficient strength and with adequate supports to provide a stable horizontal platform during firing;
- fitted with an appropriate frame for attachment of the mortar tubes;
- fitted with a removable top to permit firing from the mortar; and
- provided with sides constructed of wood or lined internally with wood or other non-metallic material — the frame of the sides may be made from metal.

Securing and supporting mortars for aerial shells

Mortars for aerial shells may be secured to stakes or posts (see exclusion regarding flat metal in Section 7.2). There must be a minimum 20 mm clearance between the stake or post and the mouth of the mortar tube. Alternatively, the stake or post must not extend

beyond the mouth of the mortar so there is minimal risk of the projected aerial shell striking the stake or post on firing.

Mortars for aerial shells may also be supported by the placement of sandbags around the mortar to an appropriate height above the position of the aerial shell in the mortar.

Securing chain-fused aerial fireworks

All chain-fused aerial fireworks devices, including those not in mortar racks (e.g. Roman candle batteries, multi-tube aerial items) must be positioned securely (by the use of stakes, racks, sandbags, earth or equivalent means) to prevent hazardous movement during operations.

Supporting clusters of mortars

All mortars in a cluster must be of the same diameter and have an internal diameter no larger than 75 mm. No more than nine mortars are permitted in a cluster. Each cluster must have an appropriate independent means of support (such as duct tape and posts or stakes).

Separation and positioning of mortars

Where practical, greater separation distances than those specified in Table 9.2 should be used to provide more space for the operator and assistants to work, and to reduce the chances injuring the crew (particularly when hand-firing is employed).

Mortars firing perchlorate-based aerial shells

The minimum separation distances for mortars firing perchlorate-based aerial shells (i.e. 1.1G classification but not salutes) are provided in Table 9.2, regardless of the mortar manufacturer's recommendations. This will affect the number of mortars per rack for the firing of perchlorate based 125 and 150 mm aerial shells such that the maximum number of mortars per rack according to Table 9.1 may not be achievable for these shells.

Using the table, a mortar with an internal diameter of 150 mm would require a minimum separation from the adjacent mortar of 37.5 mm (i.e. $0.25 \times 150 \text{ mm} = 37.5 \text{ mm}$).

Note: The separation distances may be reduced if a competent person can demonstrate that a malfunctioning aerial shell exploding in the mortar will not damage or realign a neighbouring loaded mortar.

Table 9.2 Minimum mortar separation for perchlorate-based aerial shells

Internal diameter of mortar	Minimum separation
100 mm or less	No separation required
More than 100 mm to 150 mm	0.25 x diameter of largest mortar
More than 150 mm to 225 mm	0.5 x diameter of largest mortar
More than 225 mm to 300 mm	2.0 x diameter of largest mortar
More than 300 mm	Protection and separation are required

Note: This table does not apply to salutes because salutes must not be racked.

Mortars firing aerial salutes

Mortars for aerial salute shells must be individually supported and separated from other mortars by at least ten times the inside diameter of the mortar.

Salutes are not to be included in clusters or racks (although one salute may be loaded in a rack if all the other mortars are left empty).

Clusters of mortars for aerial shells

All clusters of mortars for aerial shells must be appropriately separated so that a malfunctioning aerial shell exploding in a mortar will not damage or realign a neighbouring cluster of loaded mortars.

Delay chain fusing of aerial shells

Additional protection measures may be necessary when delay chain fused aerial shells are fired (such as for sequential firing in barrages and finales). These include:

- increasing the separation distance between the mortars; and/or
- constructing suitable racks.

Such measures are necessary to prevent neighbouring mortars from being damaged or repositioned, and prevent loaded aerial shells in neighbouring mortars from suffering sympathetic detonation should a shell explode in a mortar.

The stability provided must consider the effects of sequential firing, and witnessed test firings should demonstrate that a malfunctioning aerial shell will not damage or realign a neighbouring loaded mortar. To prevent the repositioning of buried mortars, mortars must be separated from each other by at least four times their diameter.

Securing multiple racks together in a single system

Individual racks may be joined into a single group and secured, provided certain control measures have been adopted. This practice is sometimes referred to as dense packing or cubing. This design has particular benefits as it:

- creates a more stable cubic arrangement of mortars; and
- allows for easier and quicker set up, particularly on barges or other sites where access can be difficult, because a large number of racks and mortars are carried as a single item.

The control measures for securing multiple racks together into a single system include:

- use of racks of previously tested design and performance;
- application of the requirements applying to individual racks in the above sections (e.g. stand-off distances);
- securing of racks together (e.g. by cross braces) — methods of securing the system must meet the general requirements for securing;
- loading of mortars from the inside to the outside and, after firing, checked from the outside towards the inside;
- use of no more than the number of mortars per rack as indicated by Table 9.1;
- maximum permitted shell size of 150 mm diameter for racks; and
- use of no more than 12 racks in any dense pack grouping.

Loading of aerial shells

Aerial shell fireworks must be loaded at the set up area at a safe distance from protected works and the public. The reloading of aerial shells into mortars during an outdoor event is prohibited.

An aerial shell must be carried by its body and not its fuse, unless the manufacturer and supplier have explicitly recommended carriage by the fuse in the safety and performance information provided.

Aerial shells must be checked to ensure a proper (i.e. close sliding fit) into the mortar. Shells that do not fit into their appropriate mortars must not be used. They must be labelled 'REJECT', put aside and the supplier notified, as required under the contractor's explosives management plan and the supplier's quality management system. Rejected shells should be dealt with as specified in Section 12.3.

10 Onsite setting up

10.1 Aerial and ground fireworks

General requirements

The operator must ensure that all aerial and ground fireworks and associated equipment are positioned securely in accordance with the contractor's instructions, so they will remain in position when the fireworks are fired or malfunction. Poles for ground fireworks must be securely placed and firmly braced so they will not fall over when the fireworks function. The operator must ensure that all secured fireworks and equipment have been checked for strength and stability.

The surface of the set up area where the fireworks will be secured determines the methods of securing. Methods of securing at one site (e.g. sports oval) may not be adequate for another (e.g. sandy beach).

Mortars for aerial shells

Except for exclusion zones that are fully surrounded by the public, mortars may be located and angled so that aerial shells are carried away from the public to the fallout area. Where an exclusion zone is fully surrounded by the viewing area, the mortars may be located and slightly angled to compensate for wind and the configuration of the exclusion zone.

Immediately before an aerial shell is loaded into a mortar, the mortar must be examined to confirm that no water, foreign bodies or debris have entered during set up operations. The shell assembly must be loaded into the mortar so the lifting charge is beneath the shell, with the arrow pointing upwards when the shell is gently lowered into the mortar.

While being lowered into the mortar, the aerial shell must be held by its fuse or by lowering a cord (where provided) so the shell comes gently to rest at the bottom of the mortar, resting on its lifting charge. The correct seating of the shell may be confirmed by slightly raising and lowering the shell or by measuring the depth of the shell using a marked loading rod.

Once the aerial shell is loaded in the mortar, any person (including an operator and assistants) must not pass any part of the body directly over the mouth of the mortar. A mirror may be used to inspect the interior of the mortar. The aerial shell must have the correct clearance in the mortar tube as specified in Section 4.3.

10.2 Electrical firing

Electrical firing involves the use of electric matches and an electrical firing unit (or controller). The electrical firing unit can range from a very simple device to a computer unit synchronised to music.

With proper training, experience and equipment, the electrical firing of fireworks improves safety for the operator and assistants, who are isolated from the fireworks as they are fired. This is a higher order risk control measure using the control hierarchy and is strongly recommended.

General steps involved

In setting up an electrical firing event, an operator (or assistant) will:

- ensure potential ignition sources are isolated (e.g. mobile phones, pagers, radios);
- prime the fireworks with an electric match in their respective positions at the set up area — alternatively, fireworks may have been primed at the workshop and transported to the set up area;
- ensure the lead wires of electric matches are kept shunted until the operator (or assistant) is ready to make the connection to the firing unit;
- lay the firing wires or cables from the fireworks to the firing point;
- ensure the firing system wires are shunted;
- ensure both ends of the wires are shunted without coming into contact with the firing unit until the operator (or assistant) is ready to make the connection;
- ensure the firing wires are identified or marked in accordance with the firing plan or layout of the event;
- connect the electric matches to the firing wires or cables, with the splices protected by electrical tape; and
- ensure the wire to the firing unit is not connected until ready for testing if there is an integral tester in the firing unit.

Setting up an electrical firing event

Prior to the event, the operator or assistants must inspect the electrical firing unit, cables, junction boxes, testing equipment, power supply and electric matches for serviceability and compatibility. The firing unit must not be in test or armed status during this inspection. It must be provided with at least a two-step positive interlock (with one positive interlock keyed) to prevent accidental firing.

The power sources must have sufficient power to fire all the fireworks primed with electric matches. Repairs are permitted, provided the system can be returned to full, safe operating condition prior to the event.

The electrical firing unit must be set up to permit a clear line of sight from the operator to the fireworks and other parts of the discharge site. However, this is not necessary when an operator's assistant (acting as a spotter) is in direct communication with the operator controlling the operation of the electrical firing unit.

To prevent inadvertent ignition of fireworks while they are being set up for firing at the event site (including positioning of the fireworks in the mortars), the following steps may be undertaken:

- disconnecting the cables from the electrical firing unit;
- if the circuit is shunted, inserting fuse wires into the system; and
- if a computer firing system is used, programming a protection system into the computer system.

Once the fireworks have been set up, the electrical circuits must be tested for continuity, using a galvanometer or the integral tester from the firing unit — the firing unit test circuit must be current limited to 50 mA or 20% of the no-fire current. During this test, no-one is permitted in the immediate vicinity of any fireworks that have been attached to the

electrical firing unit or in the set up area. Testing must be done outdoors and not under a roof or other covered area.

If the circuit testing indicates a problem, the operator or an assistant must visually inspect any cables, connections, splices or electric matches that appear defective and make the necessary repairs. This inspection must be performed only after the electric firing unit has been switched off or disconnected from the power source and the key removed and kept by the operator.

Electrical faults can be detected by testing isolated sections of the electrical circuit and by testing individual wires or the electric matches until the fault is detected. Where the test indicates a fault or discontinuity, defective electric matches or wires must be replaced.

Electric fusing operations

Fireworks are fused by inserting the electric match into the quickmatch fuse and securing it in position with tape or twine. Electric match wires must always be kept shunted until final hook-up at the set up area. Any operation involving the attachment, removal or repair of an electric match must be carried out:

- in a dedicated area, either at the event site or offsite in the contractor's or operator's workshop; and
- remote from people, protected works, storages of fireworks (including magazines) and other features that represent an unacceptable risk should the fireworks accidentally ignite.

As described in Section 9.1, great care must be taken when fitting and removing electric matches from fireworks.

The quantity of fireworks being worked on at any one time must be kept to a minimum. Cartons of fireworks must be kept outside the workroom and fused fireworks must be regularly removed from the room.

Direct fusing into the lift charge of aerial shells is prohibited. If mortars secured by rack systems are being used to support aerial shell mortars, the shells should be fused in such a way that shells are fired progressively from the outside to the inside of the array of mortars. This will reduce the overall consequences if a shell malfunctions in an individual mortar.

Section 9.1 also covers the safe repair and cutting of fuses.

Electrical firing hazards

Electric matches may inadvertently ignite because of their sensitivity to the following:

- friction, such as the rough attachment or removal of electric matches or quickmatch;
- impact, such as dropping the electrically fused firework;
- radio transmissions and radio frequency energy; and
- stray electricity, such as electrostatic discharges and electrical storms, inadvertent contact with phones, radios, pagers or other ignition sources.

Therefore appropriate precautions and good work practices must be adopted, such as:

- maintaining appropriate distances from the sources of electromagnetic radiation;
- twisting (shunting or shorting) the wire at all times;
- not coiling wires;

- evacuating the set up area of all personnel to the perimeter of the exclusion zone and returning loose products to storage at the approach of an electrical storm; and
- not using portable communication systems (such as radios and mobile phones) within five metres of electrically fired fireworks.

Note: Communication systems may be used after the event is set up and all personnel are away from the fireworks.

Section 8.8 contains more information on the hazards of extraneous electricity and precautions to be adopted.

Location of electrical firing point

When only electrical ignition is to be used, the operator and assistants should be positioned as far as practicable from any mortar, preferably behind a suitable protective barrier. For events on barges or rooftops, a suitable protective barrier may be required unless the separation distances can be met. These protection measures are not required for the electrical ignition of lance work and other small low hazard ground-level fireworks. The electrical firing point must be positioned so there is a clear line of sight to the set up area and all the fireworks primed for electrical firing.

If both manual firing and electrical ignition are to be used during an event, the mortars to be used for manual firing must be separated from the mortars to be used for electrical ignition by a distance of at least ten metres.

Only electric firing permitted

There are certain applications where only electric firing provides an acceptable level of risk for outdoor events and these are:

- dense packs of aerial shells;
- aerial shells greater than 200 mm in diameter;
- ground fireworks from elevated positions; and
- aerial shells on floating vessels or platforms.

10.3 Manual firing

Safety caps protecting fuses must not be removed until immediately before the aerial shells, or rows of aerial shells, are to be fired.

10.4 Confinement of fireworks

Fireworks must not be unnecessarily confined.

Necessary confinement means the confinement of fireworks by equipment that is essential for the operation of the fireworks. For example, single aerial shells and mines require confinement in a mortar for their operation. Fireworks such as multishot cakes, barrages and candles use confinement in their design to project the fireworks effects.

Unnecessary confinement means using additional encasing or enclosing equipment not required for the production of the desired effect. For example, securing candles or cakes with pipes is unnecessary confinement.

A firework is subjected to unnecessary confinement when:

- more than 25% of the sides (not counting the top and base) of the firework are enclosed by the equipment; or
- there is a clearance of less than 25 mm between the firework article and the equipment.

The contractor, in the standard operating procedures, and operator, at the event site, must not unnecessarily confine fireworks. Unnecessary confinement of fireworks is avoidable and increases the risk of harm to people from flying fragments. Fireworks such as Roman candles or fountains can be properly supported without confinement. The elimination of confinement is the only risk control measure from the risk control hierarchy that should be applied.

10.5 Securing fireworks and equipment

All fireworks and associated equipment must be properly secured so the fireworks and equipment do not fall over during an event, either through normal or abnormal functioning of the fireworks. Inadequately secured fireworks can shoot burning material towards the crowd, causing serious injuries and fires.

The methods of securing fireworks should take into account:

- weather conditions, such as rain, which will reduce the strength of cardboard and render adhesives and fasteners ineffective; and
- the surface on which the fireworks are being secured, such as soil, sand, hard surfaces or a pitching barge.

The contractor must develop methods for properly securing fireworks. The explosives management plan must document the methods, procedures, practices, equipment and materials for securing fireworks. The operator should only secure fireworks in accordance with the contractor's explosives management plan. Fireworks equipment must be capable of withstanding large forces without being disturbed, dislodged or knocked over. Using gravity as the sole method of securing fireworks is not acceptable under any circumstances.

Appendix 11 provides information on the recommended methods of securing fireworks for different surfaces and applications.

11 Conducting the event

11.1 Commencement of the event

General conditions

The operator may commence the event only when:

- requirements of the Explosives Regulations and this code of practice have been observed;
- risk of harm to people and property is at an acceptable level and it is safe to commence the event;
- all applications, licences and approvals from all agencies have been undertaken and are in order;
- all personnel with duties for the event are ready and in position; and
- advertised time for the event has arrived.

The operator must record the relevant information, including the set up, personnel, conditions and any other features of the event. Such information should be recorded in a document such as an event worksheet, logbook or equivalent. This will permit the operator to assess whether the above criteria have been met. Activities undertaken by the operator to confirm that the criteria have been met will include ensuring:

- an appropriate calculated minimum clearance distance and exclusion zone for the actual conditions;
- security of the exclusion zone;
- proper set up and securing of the fireworks and fireworks equipment;
- preparedness of operator's assistants and the event organiser; and
- documentation of the time of commencement.

Responsibilities of event organiser

The event organiser must be satisfied that his or her responsibilities for the conduct of the event have been met before the operator starts the event. The event organiser must not direct, or knowingly permit, the contractor or operator to undertake activities that are in contravention of the Act and Explosives Regulations. This covers all activities involved with the event, including planning the event, setting up the event, managing the event and post-event activities.

Furthermore, the event organiser must not direct or pressure the operator to proceed with an outdoor event when the operator considers that it is unsafe or inappropriate to do so.

Weather conditions

On the day of the outdoor event, the operator must determine the likely weather conditions at the time of the event from Bureau of Meteorology forecasts or other reliable sources. The event must be set up taking into account the anticipated weather conditions. If the wind speed is more than 50 km/h (27 knots) the event must not proceed.

11.2 Suspension, postponement or cancellation of event

Unfavourable or changing conditions

The operator must respond to conditions before the event commences and changing circumstances during the conduct of the event.

If conditions are unfavourable, the operator must either:

- modify the event (e.g. only fire the smaller calibre fireworks) to ensure that the exclusion zone is appropriate for the actual conditions; or
- delay, postpone or cancel the event.

If adverse conditions or a change in conditions (e.g. significant change in wind speed or wind direction) present a risk to safety, the operator must stop the event. The operator may recommence the event when the operator is satisfied that it is safe to do so. The operator must advise the event organiser accordingly.

Adverse weather conditions

If the operator considers that adverse weather condition (e.g. high winds or precipitation) presents a new increased and significant hazard, and hence unacceptable risk, the event must be postponed until the weather conditions suitably improve.

If, during the event, a change in wind direction or speed increases the clearance distance required for the event such that it is greater than the clearance distance provided for the event, the operator must reassess the situation for safety.

The operator may adopt risk control measures to address such a situation, including:

- firing only those fireworks that meet the clearance distance requirements for the set up; or
- at the planning stage, providing a margin to exceed the minimum clearance distances for a particular prevailing wind direction to avoid problems of this nature.

If the weather conditions cause fallout and discharge to extend beyond the fireworks exclusion zone, the operator must stop the event. The event may resume when the fallout and discharge for the remaining fireworks to be fired will not extend beyond the fireworks exclusion zone. This may mean not firing selected fireworks that cannot meet the fallout and discharge requirements. Alternatively, changes may be made to the exclusion zone to permit recommencement of the event at an acceptable level of risk.

Access by spectator crowd to the exclusion zone

If the spectator crowd enters the exclusion zone during the event through ineffective security or barriers in controlling the crowd, the operator must stop the event. The event may resume only when the operator is satisfied that the exclusion zone will not be entered and the spectator crowd is under control.

Malfunctioning fireworks

If malfunctioning fireworks cause, or are suspected to cause, harm to people or damage to property (including fireworks at the event) during the event, the operator must stop the

event. The event may only resume when he or she has confirmed that it is safe and appropriate to do so.

Incident during event

If an incident occurs during the event, the emergency plan should be implemented. The event must be immediately stopped until the operator has confirmed that it is safe and appropriate to resume the event.

11.3 Personnel

Personnel in exclusion zone

The operator must authorise and control all personnel permitted within the exclusion zone during the event. The number of such authorised personnel must be kept to a minimum. Tabards, uniforms or identification tags may be used as a means of identification where it is necessary to issue instructions to unauthorised personnel (e.g. for security personnel).

The operator must ensure that no person is allowed in the exclusion zone while apparently under the influence of alcohol, narcotics, banned substances, medication, fatigue or other conditions that could adversely affect judgment, mobility, or stability.

Crowd control personnel

Personnel with responsibilities for crowd control must be properly identified and trained for their duties.

Spotters

General functions

The operator must appoint one or more spotters to observe the flight and behaviour of aerial shells and other fireworks to confirm that they are functioning as intended. If an unsafe condition is detected, such as hazardous debris falling onto the public, the spotter must immediately notify the operator to cease firing until the hazardous situation is corrected. The spotter must be in direct communication with the operator during the conduct of the event, with an effective means of informing the operator of any hazardous situation.

Observing trajectory of fireworks including aerial shells

The trajectory of the first firework fired must be carefully observed to confirm that the remaining fireworks will function over the exclusion zone and that any hazardous debris or duds will fall within the exclusion zone. If the first firework fired is not an aerial shell, then the first aerial shell fired must also undergo the same assessment. If the initial trajectory is incorrect or there is a change in wind conditions, alterations to the set up or exclusion zone may be required.

Emergency services personnel

When present, emergency services personnel, such as FESA and ambulance service personnel, and their vehicles must remain at or beyond the perimeter of the exclusion zone during the actual firing of the event. If a situation requires the entry of emergency

services personnel into the exclusion zone, the operator must halt the event until the situation is resolved and the exclusion zone is once again clear.

11.4 Safety equipment

Personal protective equipment

All personnel within the exclusion zone must wear PPE during the event. PPE must suit the identified hazards and the person's location during the event. Personnel exposed to flash, flame, impact, loud noise or smoke from fireworks during the event must wear suitable safety equipment based on risk control principles. The following are necessary:

- eye or face protection (i.e. safety glasses or full face shield);
- hearing protection (the selection may provide for the firing of lifting charges to be heard);
- impact protection (i.e. safety helmet and safety boots);
- natural fibre clothing such as full-length cotton overalls or long-sleeved cotton shirt and long cotton pants — short-sleeved cotton shirts are permitted as a suitable alternative during set up activities; and
- respiratory equipment if thick smoke is expected.

Operators who hand-fire fireworks are exposed to the greatest risk. Operators who electrically initiate fireworks from outside the defined clearance distances of the exclusion zone do not necessarily require PPE during the firing of the event.

If an operator considers that various items of PPE are not necessary to protect personnel within the defined clearance distances of the exclusion zone, the operator should undertake a documented risk assessment to confirm that such equipment is not required. The contractor should make this risk assessment available to the operator, assistants and other personnel as appropriate under the requirements of the OSH Act.

Fire fighting equipment

The operator must locate at least one 2A water (nine litre) fire extinguisher and one 20 litre container of water at each point of launch at the event. Fire fighting equipment superior to these minimum requirements is encouraged.

During restricted and prohibited burning times, a fire fighting vehicle with two operators must attend the event, as described in Section 8.9.

11.5 First aid

At least one qualified first aid provider should be present at the event. A dedicated first aid provider should be on duty at the event outside the exclusion zone and must be dedicated to that duty and not otherwise involved in the event. A person who is a registered nurse, ambulance officer or medical practitioner is an acceptable alternative to a qualified first aid provider.

11.6 Initiation

Instructions for firing

Outdoor fireworks must be initiated in accordance with operating procedures that are documented in the contractor's explosives management plan.

Hand-firing

Safety caps may be removed from rows of cakes and mortars immediately before the start of an event. The hand-firing of fireworks must be done by lighting the tip of each fuse with a portfire using the 'extended arm' technique. As soon as the fuse is lit the operator must move away, so a clear exit path is required. The time delay between ignition of the exposed black match and initiation of the item must allow the operator sufficient time to move away and avoid injury. No body part is allowed to pass over the mouth of the mortar during this operation.

Inexperienced operators firing aerial shells require a three-second delay. Using risk assessment principles, experienced operators may reduce this delay down to a minimum of one second when hand-firing aerial shells less than 200 mm in diameter. Aerial shells 200 mm or more in diameter always require a three-second delay regardless of operator experience. Salutes also require a three-second delay regardless of operator experience. Rows of mortars and mortar racks may be hand-fired but dense packs require electric initiation.

Electrical firing

Electrical firing units and accompanying junctions must be manufactured specifically for the electrical initiation of fireworks. Before initiation, electrical circuits must be tested for continuity at 50 mA or 20% of the no-fire current, whichever is less. The operator must only initiate fireworks when satisfied that it is safe to do so, and only personnel necessary for the proper and safe firing of the event are permitted near the electric firing unit.

Note: On some occasions, with the approval of the event organiser, an invited member of the audience may electrically initiate fireworks under the close supervision of the operator responsible for the event.

Electrically fired pieces do not require safety caps but fireworks composition must not be exposed and fuses must be protected against accidental ignition. Electrically fired events do not require a delay period.

Ignition sources

Mobile phones must be kept at least five metres from electric matches and fireworks prepared for electric initiation. Only ignition sources that are approved by the contractor in the explosives management plan are permitted within the exclusion zone. Permitted ignition sources may include portfires and flashlights. Examples of ignition sources that are not approved include lit cigarettes and matches. Firework events must be postponed or cancelled if lightning strikes are occurring in the vicinity.

Malfunctioning aerial fireworks

When a manually fired aerial shell fails to leave a mortar, that mortar must be marked or tagged as soon as practicable to indicate the presence of an unfired aerial shell. When the operator or an assistant detects such a failure, they must warn other people in the area. The mortar must be isolated as long as the misfired aerial shell remains inside.

When an electrically fired aerial shell fails to leave a mortar it does not require immediate marking. However, personnel entering the area after the event must be warned that an unfired aerial shell remains. At the end of the event, the mortar must be tagged to identify the presence of a malfunctioning shell. A good method to assist in identifying unfired aerial shells is to use witness covers.

Refuge for operators and their assistants

The operator and assistants located within the exclusion zone during the event may take refuge in a shelter. Appropriate PPE should be worn in the shelter so that any incidents can be attended as quickly as possible.

11.7 Firing from special locations

Special requirements apply to fireworks launched from unusual locations such as:

- elevated locations (e.g. tops of buildings);
- floating vessels and platforms;
- moving platforms;
- moving vehicles and aircraft; and
- places near sensitive areas or vulnerable facilities.

Elevated locations

This subsection covers the firing of ground fireworks from elevated locations. It does not apply to:

- devices normally fired off stakes, provided the stakes are fixed in the ground or devices designed to be fired off chains;
- theatrical fireworks initiated from elevated locations (e.g. streamer cartridges, gerbs, airbursts);
- aerial fireworks fired from elevated locations (a banned practice); or
- ground fireworks fired on embankments or where the ground has been raised.

An elevated location is defined as a location where the point of initiation of the fireworks exceeds six metres above ground level. The written consent of the owner of the structure must be obtained before any event involving an elevated location is planned.

Structure

The structure or platform from which fireworks are fired must:

- be sufficiently stable to endure the setting up and firing of fireworks under unexpected weather conditions;
- have a safe means of egress; and
- have a barrier fitted to the edge of the platform — alternatively, where no barrier is fitted, the operator and the assistants should have safety lines fitted to themselves according to the OSH Act requirements.

Where the structure is a building and there are openings into the building, the openings should be suitably protected to prevent fire and smoke alarms being activated, or security being breached. Alternatively, it may be necessary for fire and smoke detectors to be isolated for the duration of the event and sufficient time after the event for the smoke to dissipate (additional mitigation and consultation with FESA may be required).

Products

The products used at elevated locations should be:

- tested previously by the operator (at ground level) to determine their suitability to be fired from elevated locations;
- of the type that is self-consuming producing little or no fallout (i.e. no plastic, cardboard or wadding that could cause injury); and
- of the type that any pyrotechnic materials have extinguished before returning to the firing height of the device.

Operator

Only an experienced operator is allowed to conduct events at elevated locations. The operator must have a fireworks operator licence (endorsed for unrestricted use) or have been given special permission by the Chief Officer.

Surface of platform

The surface from which the fireworks are to be fired should be made from non-combustible materials. Where this is not the case, appropriate safeguards should be put in place to prevent damage to the surface.

Securing of fireworks

The fireworks should be sufficiently secured to prevent them from falling over or off the platform. For example, box items should be wired to nails in baseboards, and candles should be secured in non-metallic mortar racks with timber supports or sandbags.

The primary consideration for locating fireworks at elevated locations, particularly stadium roofs, is the placement of racks and baseboards where they are supported by the structure of the roof. For example, racks and baseboards should be placed along lines of roofing nails or screws where the structure of the roof is at its strongest. Allowances need to be made for stronger winds at elevated heights when securing fireworks.

Position of fireworks

The following should be taken into account when positioning fireworks:

- adequate clearance distances to the public (see Table 11.1);
- for roofs that have a ridge or some other form of barrier, placing the fireworks behind the barrier furthest from the public;
- avoiding any physical damage to any structure or attachments near the elevation position — for rooftops this includes mobile phone aerials, radar dishes, infra-red transmitters and television aerials; and
- sloping roofs causing fireworks to be angled off true vertical.

Note: Crossettes must not be used when proximity to neighbouring buildings is an issue.

Table 11.1 Standard clearance distances for elevated ground fireworks

Elevated ground fireworks	Standard clearance distance 'R'
Set pieces – lancework only – incorporating fountains	15 m 30 m
Fountains, revolving fountains and flares	30 m
Mine bags, multi-shot box items, Roman candles, comets and mines	45 m

Exclusion zone

The firing of ground fireworks from elevated locations is permitted provided there are no spectators within the exclusion zone around the firing point.

When determining the area of the exclusion zone around a building, the firing position is placed within an imaginary cylinder where the radius 'R' is the standard clearance distance for the largest piece being used. This cylinder extends upwards indefinitely above the point of initiation, and downwards for a distance of 2 x R from firing point level, or until the ground is reached, as shown in Figure 11.1.

Where the firing platform is a spark-proof barrier such as a stadium rooftop, the above requirements still apply, but spectators may sit under the platform if they are not within the area that is 45° inwards from the edge of the roof, as shown in Figure 11.2.

The operator must consider wind speed and direction at the time of the event when calculating the exclusion zone, and alter the clearance distances accordingly (or eliminate certain pieces) to ensure the safety of spectators.

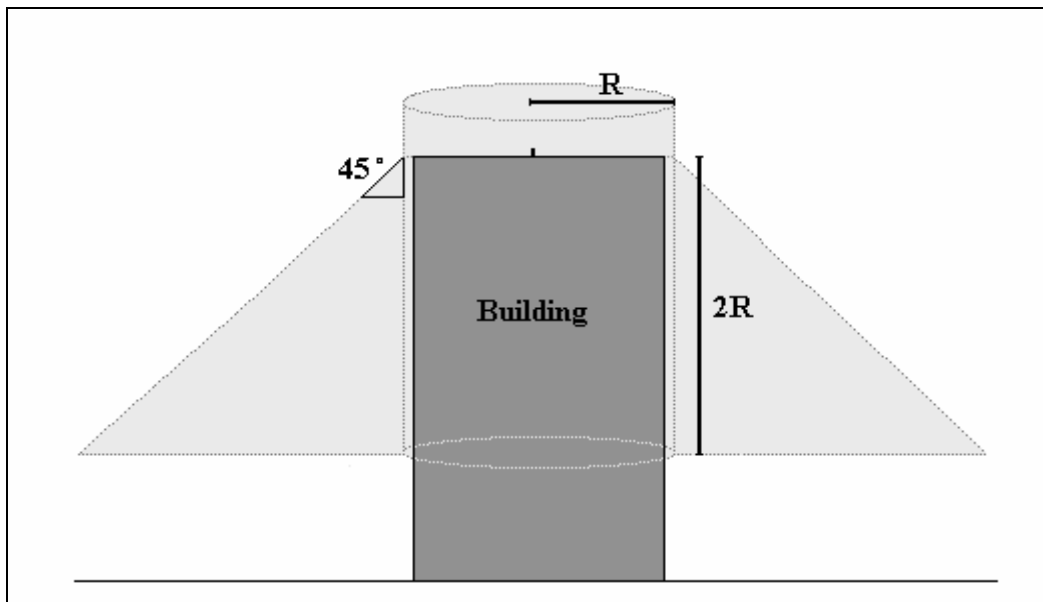


Figure 11.1 Exclusion zone for ground fireworks on a building

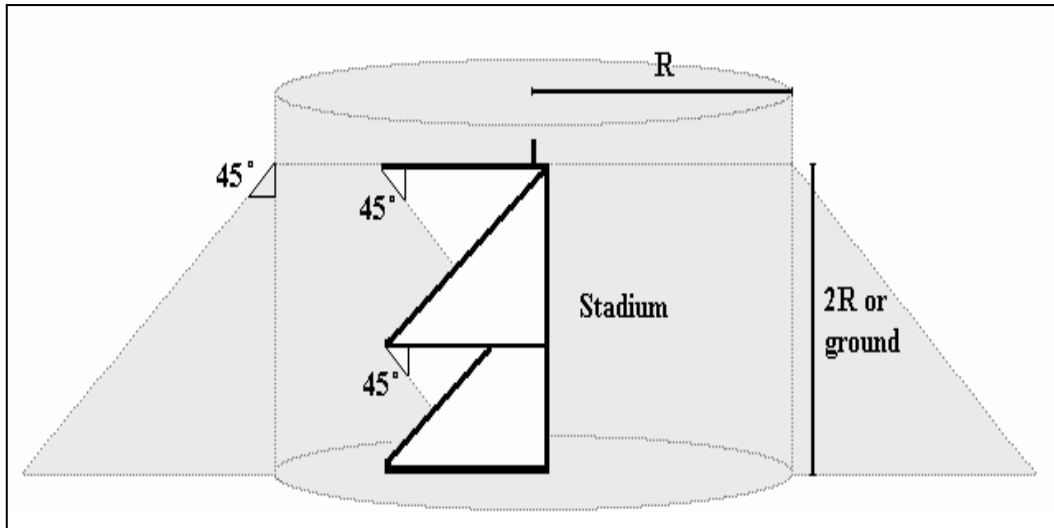


Figure 11.2 Exclusion zone for ground fireworks on a stadium

Note: If the wind is coming from the rear of the stadium then the 45° angle protecting spectators within the stadium may be replaced with a vertical drop to ground level.

Loading operations

When carrying fireworks to elevated locations, the following should be considered:

- the firework pieces must be brought to the set up area in their original packaging, no loose fireworks are to be brought to the point of initiation;
- mortars are to be carried empty to the set up area — they are not to be loaded at any place other than at the point of initiation;
- for building roofs, the fireworks are to be brought to the set up area outside of peak traffic hours to minimise contact with the public — the operator must liaise with building management and onsite security on the safest access and time to take the fireworks to the firing site;
- for stadium roofs, fireworks should only be loaded when the public is not present and mortars should not be reloaded while the public is present; and
- where the fireworks are to be 'fanned', they must not be angled more than 15° off true vertical.

Initiation

Firing of ground fireworks from elevated locations must only be by means of electric initiation. Pieces must not be fired by hand. Remote electric initiation using a radio transmitter (producing a coded signal) is permitted subject to approval from the Chief Officer.

Assistants and spotters

There must be at least one assistant at the elevated location to assist the operator. Spotters in communication with the operator are also required to keep a watch on any sensitive areas that the operator cannot see directly.

Transmitters

Where there are radio transmitters, or any other extraneous sources of ignition near the elevated location, the initiation point of the fireworks must be outside the safe separation distance as recommended in Table A10.1 for the maximum power output and frequency of the transmitter.

Floating vessels and platforms

Firing fireworks from a barge or floating platform, such as a raft or pontoon, presents a special hazard since this type of platform can be made unstable by waves and currents. The floating platform can recoil from the fireworks being fired, causing it to shift and the trajectory of an aerial shell to deviate. Space is also much more confined than on conventional land sites, and the operator and assistants cannot move about the platform as freely. Additional hazards and risks on vessels and platforms include:

- closer proximity of the operator and assistants to the fireworks;
- increased potential for the operator and assistants to slip or trip; and
- hazards associated with the water itself.

Construction

A floating vessel or platform must be of sufficient strength and stability to enable all activities associated with the firing of the event to be conducted safely. The types of fireworks and the placement of the fireworks, fireworks equipment (including mortars and securing equipment) must not jeopardise the stability of the site structures and seaworthiness of the floating vessel when the fireworks are fired.

Identification

The floating vessel or platform must be identified as an explosives vessel or platform from the time that the fireworks are taken on board at initial set up until the operator declares the vessel or platform free from fireworks.

The platform or vessel must be fitted with the standard fireworks warning signs described in this code of practice. The number of signs used should be based on permitting the ready identification of the presence of fireworks on the barge from the perimeter of the exclusion zone during day and night in:

- all conditions of weather; and
- from all four sides of approach.

The platform or vessel may also be required to fly flags and a red light at night in accordance with international maritime requirements.

Staffing

A floating vessel or floating platform may not be staffed, provided:

- operator remains in control at all times of the floating vessel or floating platform and firing of the event; and
- security of the exclusion zone is maintained.

No flammable and combustible materials on floating vessels

Floating vessels and floating platforms must be free of all non-essential flammable or combustible materials. Any permanently mounted equipment on board the vessel not being used and containing flammable or combustible material (e.g. motor fitted with fuel

tank) must be shielded from exposure to the fireworks. Portable power-generation equipment and material-handling equipment deemed necessary for the performance of the event are permitted.

Safety shelter

Floating vessels and floating platforms that are staffed during electrical firing must have a safety shelter located as far as practicable away from the fireworks. The safety shelter must be designed and constructed to withstand the impacts and effects from the fireworks to be fired. The design must also:

- be of sufficient size to accommodate all personnel present during the actual firing of the event; and
- provide adequate protection for these personnel from the event set up and above (e.g. malfunctioning fireworks, dud aerials).

The design may include an observation window made of laminated glass protected by expanded metal or polycarbonate sheeting to allow observation of the firing by the operator and assistants.

Requirements for fireworks

Fireworks may be fired from a platform or vessel if:

- aerial fireworks are fired electrically; and
- appropriate calculated minimum clearance distances are complied with — the calculation of the clearance distance must include an additional provision for the firework firing up to an additional angle of 5° from true vertical, depending on the stability of the platform.

Storage

The storage of fireworks for a future event on board a floating vessel or platform when the floating vessel or platform is already set up for an event is prohibited.

Moving platforms and aircraft

The firing of fireworks from a moving vehicle or platform (including any land-based or water-based vehicle) or an aircraft requires the approval of the Chief Officer. The request for approval must be accompanied by a documented risk assessment. Other agencies, such as CASA, local authorities and FESA may also require special approval to be granted. This requirement does not apply to a barge able to remain under tow and capable of moving during the event.

Near vulnerable facilities

Vulnerable facilities are densely populated buildings that cannot be evacuated easily (e.g. health care facilities). The contractor should negotiate with the event organiser and, following a 'prudent avoidance' policy, try to arrange for proposed events near vulnerable facilities to be held elsewhere. Failing this, the contractor should either decline to do the event or raise the issue with the Chief Officer.

11.8 Responding to incidents

All fireworks accidents and incidents, which are emergencies, must be reported in the usual manner to seek emergency assistance from the WA Police, FESA or ambulance

services as appropriate. In addition, any accident, incident or significant near miss, whether or not it causes injury or damage, must be reported to Resources Safety.

In the case of a serious fireworks incident (e.g. one involving serious bodily injury), Resources Safety should be notified as soon as possible. Other agencies (e.g. WorkSafe) may also require notification of an accident, incident or near miss under the requirements of their legislation.

In addition to assisting people in the case of an accident or incident, the operator is required to:

- ensure that the accident or incident area is isolated and undisturbed until the control of the site has been handed over to the WA Police, Resources Safety or any other relevant authority (or as directed by those agencies); and
- record, and make available for the investigation, the names and other details of the people injured by, involved in, or witness to, the accident or incident.

If an accident or incident causes a fire during the event, the operator must immediately stop the event and initiate the appropriate emergency procedures.

12 After the event

12.1 General requirements

This chapter covers the activities that should be undertaken after an event has concluded to ensure that the exclusion zone and surrounding areas are made safe. The operator may then return control of the area to the event organiser.

Personnel must not enter the set up area and post-event activities must not commence in the exclusion zone until the operator has deemed that it is safe to enter the site and surrounding areas.

Use of personal protective equipment

Personnel involved in post-event activities must wear PPE as instructed by the contractor and according to the explosives management plan. People at risk should a firework function during clean-up activities (e.g. handling live fireworks) must wear PPE, including safety footwear and protective clothing (long-sleeved cotton shirts and long cotton pants are acceptable).

Clean-up of the fireworks exclusion zone

The operator and assistants must clear the exclusion zone and surrounding areas of all debris, equipment and rubbish associated with the event. This should be done immediately after the event and, if lighting is inadequate, a follow-up search should be done the following morning at first light.

12.2 Inspecting fireworks and equipment

General requirements

The operator should not return control of the exclusion zone to the event organiser until it and surrounding areas have been effectively searched and cleaned, and present no hazards arising from the event.

When poor lighting conditions prevent a thorough inspection of the zone and surrounding areas, the operator must arrange for the entire site to be secured and inspected again the following morning.

Inspecting electrical firing equipment

Following events using electrical initiation, the operator must ensure that the electrical firing equipment has been turned off and isolated from all power sources before proceeding with other post-event activities. All cables connecting the electrical firing unit to electric matches must be disconnected.

Searching for and inspecting unexploded fireworks and fireworks components

The operator and assistants must inspect the exclusion zone to locate any unexploded fireworks and fireworks components. While debris fallout and erratic or malfunctioning

fireworks are normally contained within the exclusion zone, they may extend to surrounding areas. Fireworks remnants should be checked for any malfunction.

Inspecting fireworks equipment

Hang fires, which can last for up to 30 minutes, must be identified and made safe. The operator should inspect all equipment (including methods of securing the fireworks and equipment) for damage and failure. Any damaged equipment should be identified and tagged. Equipment should be disposed of at a later date or repaired before reuse. Repaired equipment should not be reused until deemed fully serviceable.

12.3 Dealing with unfired or misfired fireworks

Misfires must be dealt with in accordance with the operating procedures of the contractor's explosives management plan. The procedures must be based on the following requirements or equivalent safety performance.

Where practicable, the area surrounding an unfired or misfired firework (including any aerial shell found during the search) must be isolated to an area at least equivalent to its bursting diameter. The firework must not be handled until at least 30 minutes after the firework was unsuccessfully fired.

Common fireworks malfunctions are listed in Appendix 12.

Unfired mortars

An unfired mortar must be tagged as soon as possible and, after the required 30-minute wait, irrigated with water and left for another five minutes before the shell is removed.

Salvaging fireworks

Fireworks that are fully serviceable and have not been fired for various reasons (e.g. changing weather conditions) must be properly packaged for transport away from the site for future use. When electrical initiation is used and the failure is electrical in nature and the cause of misfire is identified, the fireworks (including aerial shells) may be appropriately marked and salvaged by the operator.

Faulty fireworks must be returned to the contractor for return to the supplier or stored at a licensed magazine prior to disposal. Records of any unused fireworks at an event must be kept by the contractor and operator indicating the actions taken with those fireworks. The transport and storage of these fireworks must be undertaken in accordance with the Explosives Regulations.

Note: During fireworks salvage, care must be taken when removing electric matches from quickmatch (this should be done outdoors).

Disposing of fireworks containing residual fireworks composition

The supplier of the fireworks is responsible for providing disposal instructions with the supply of the fireworks. This information should be provided in the MSDS, TDS and other safety information, and incorporated into the contractor's explosives management plan.

All fireworks used in the event, which contain residual fireworks composition, must be rendered safe and destroyed. They may be disposed of onsite or prepared for transport from the site for destruction at a suitable location. Where conditions allow, the operator

may be permitted to safely fire any unfired fireworks or components after the event, provided:

- the operator has undertaken a risk assessment to confirm that it is safe to do so; and
- clearance distances are suitable.

Misfired fireworks must not be disposed of by burning in an open fire unless the destruction takes place at an approved disposal facility.

Fireworks and any components of fireworks containing explosive composition must be rendered safe for transport away from the event site. They should be placed in water to ensure that the fireworks composition cannot be ignited, and then transported away from the event site in a superior package.

In addition to complying with the requirements of the Explosives Regulations, the operator should dispose or destroy fireworks and other materials associated with disposal activities (such as water used to douse fireworks) in accordance with FESA, Department of Environment and Conservation and local government requirements.

12.4 Disposal of unwanted fireworks

Unwanted fireworks require safe disposal so that they do not present a danger to the community. Fireworks must not be thrown into rubbish bins for disposal.

After an event the operator may store unwanted fireworks at his or her residence, in quantities not exceeding those listed in Table 5.1, before taking them to the contractor's disposal facility at the earliest opportunity.

Manufacturer's instructions should be followed when disposing of fireworks. MSDS and TDS details should be available from the manufacturer or supplier.

When the manufacturer's instructions are not available, the recommended disposal method is to submerge the fireworks in water as soon as possible and burn them later.

The quantity and types of fireworks must be recorded for stocktaking purposes when the disposal process is completed.

12.5 Notifications and record keeping

The operator must notify the contractor who in turn must advise the fireworks supplier of:

- safety issues associated with the fireworks as soon as practicable; and
- any quality issues regarding the fireworks as soon as practicable, but no later than seven days from the date of the event.

Documentation and records

The contractor and operator must keep documentation and records associated with each event for a minimum of three years, including:

- fireworks event permit;
- conditions, circumstances and details of the event (e.g. fireworks industry worksheet or equivalent); and
- stock reconciliation.

Appendix 1 – Legislative framework

Dangerous Goods Safety Act and regulations

The management of fireworks in Western Australia is covered by the *Dangerous Goods Safety Act 2004* (the Act) and the Dangerous Goods Safety (Explosives) Regulations 2007. The Act applies to all activities involving the safe and secure management of dangerous goods including fireworks.

The Act imposes a duty to minimise risk on all people involved with fireworks. It requires that a person who is engaged in activities involving fireworks must take reasonable measures to minimise the risk to people, property and the environment. The Act gives force to the Dangerous Goods Safety (Explosives) Regulations 2007 and any standards and codes cited therein.

Standards and codes

The safe and secure management of fireworks is also covered by various standards and codes, including:

- Australian Standard AS 2187.0:1998 *Explosives – Storage, transport and use – Terminology*;
- Australian Standard AS 2187.1:1998 *Explosives – Storage, transport and use – Storage*; and
- Australian Standard AS 2187.4:1998 *Explosives – Storage, transport and use – Pyrotechnics – Outdoor displays*; and
- *Australian Code for the Transport of Explosives by Road and Rail, Second Edition*, published in 2000 and commonly referred to as the 'Australian Explosives Code' or 'AEC'.

Other applicable legislation

The Act is not the only legislation covering fireworks activities. While this code of practice is primarily focussed on the requirements under the Act, other legislation applies and may involve agencies listed in Section 8.2 of this code of practice. Other acts relevant to fireworks include:

- *Fire and Emergency Services Authority Act 1998*;
- *Bush Fires Act 1954*;
- *Police Act 1892*;
- *Local Government Act 1995*;
- *Environmental Protection Act 1986*;
- *Western Australian Marine Act 1982*;
- *Civil Aviation Act 1988*; and
- *Occupational Safety and Health Act 1984*.

Appendix 2 - Unrestricted fireworks

Unrestricted fireworks are prescribed as:

- party poppers (or streamer cones) if they do not contain more than 1.6 grams of composition per 1,000 of such fireworks;
- percussion caps for toy guns (amorce caps);
- snaps (e.g. for bonbons, Christmas crackers and party poppers) if they do not contain more than 1.6 grams of composition per 1,000 of such fireworks;
- starting pistol percussion caps; and
- throwdowns if they do not contain more than 2.6 grams of composition per 1,000 of such fireworks.

Unrestricted fireworks should not be initiated in a public place in a manner that creates a public nuisance.

Note: Sparklers are not unrestricted fireworks because they must meet some dangerous goods storage and transport requirements, but the general public may use sparklers that are no more than 300 mm long.

Appendix 3 – Prohibited fireworks and equipment

Fireworks

Some fireworks are prohibited because they present an unacceptable risk of harm to fireworks industry personnel and the public. They are listed below by function, properties or generic name (e.g. sky rocket), rather than the manufacturer's product name:

- firework from which firework composition may escape;
- firework containing any type of chlorate salt in its main composition (small amounts of chlorate salts are permitted in some primer compositions, used as part of an initiation chain);
- firework (other than an unrestricted firework) containing its own means of ignition;
- firework all or part of which is projected through the air on initiation and has the potential to injure a person outside the separation distances indicated in this code of practice (e.g. sky rockets);
- bangers, bungers, crackers or similar exploding fireworks other than on chains;
- cracker chains where the individual cracker exceeds 75 mm in length or 30 mm external diameter, or which contain a final report (or banger);
- salute shells greater than 75 mm diameter or length;
- candles greater than 75 mm internal diameter;
- fountains greater than 125 mm internal diameter;
- candles greater than 25 mm internal diameter of the tube containing flash powder type compositions as the primary pyrotechnic unit;
- multishot boxed items with tubes in excess of 50 mm internal diameter; and
- multishot boxed items not meeting the specifications outlined in Table A3.1.

Note: Small amounts of chlorate salts are permitted in some primer compositions (used as part of an initiation chain).

Fireworks activities

Certain activities in fireworks manufacture and refurbishment are prohibited because they present an unacceptable risk of harm to the fireworks industry personnel and the public. They include:

- reloading of spent fireworks casings from used fireworks such as cakes and barrages;
- reloading of mortars during an event; and
- alteration of manufactured fireworks.

Fireworks equipment

The following items of equipment are prohibited because they present an unacceptable risk of harm to the fireworks industry personnel and the public:

- mortars made of metal other than as exempted in Section 7.2;
- mortars made of wood or clay other than for use in plugs;
- mortars made of PVC, ceramics or other brittle materials;
- cardboard mortars greater than 200 mm in diameter; and
- metal supports for fireworks other than as exempted in Section 7.2.

Table A3.1 Limits for multishot boxed items

Internal diameter of tube (mm) - ID	Maximum number of tubes	Maximum number of shots	Comments
38 < ID < 50	52	52	Pyrotechnic unit composed wholly or predominantly of flash powder type compositions prohibited (crossette effect permitted)
25 < ID < 38	100	100	Pyrotechnic unit composed wholly or predominantly of flash powder type compositions prohibited (crossette effect permitted)
10 < ID < 25	200	200	
ID < 10	1,000	1,000	

Appendix 4 – Risk management

Managing risk

Risk management includes maximising the probability and impact of positive events and minimising the probability and consequences of events adverse to project objectives.

Detailed information on managing risk is contained in Australian Standard AS/NZS 4360:2004 *Risk management set*.

The steps involved in the risk management process that may be applied to events and related activities are summarised below.

Establish the context

Determine the physical and organisational environment in which the risk identification, analysis and treatment options will be considered.

Identify the hazards

Identify the typical problems and concerns that might adversely affect an event and related activities, such as:

- inherent nature of the fireworks, as described in their formal classification and based on their chemical composition;
- methods by which the fireworks are normally ignited, and how and what can inadvertently ignite them;
- consequences of normal ignition, such as smoke, noise, particles from combustion and any solid projectiles;
- potential for malfunction of the fireworks, including impact on fireworks equipment and adjacent fireworks;
- effects of malfunctioning fireworks and fireworks equipment on people;
- effects of the fireworks on people outside the viewing area, the environment and other activities in the community, such as aircraft movements and livestock;
- effects of external hazards, such as weather, on fireworks; and
- threat of theft.

Analyse the risks

Determine the existing controls and then analyse the risks in terms of consequence (impact of occurrence) and likelihood (probability of occurrence of given hazard) in the context of those controls.

Identify and assess potential controls

Analyse risk mitigation alternatives, measure the effectiveness of controls and develop or modify the relevant plans to incorporate the control strategy.

Evaluate the risks

Compare estimated levels of risk against pre-established criteria. This enables risks to be ranked to identify management priorities. If the levels of risk are low, then risks may fall

into an acceptable category and treatment may not be required, although even these low risks should be reduced further or eliminated if possible.

Treat the risks

Treat risk (other than secondary risk like public liability) by applying a preferred order of control measures called a control hierarchy. Low priority risks may be accepted and monitored, but higher priority risks require the development and implementation of a specific management plan.

In addition, risk management processes, both mandatory and of an advisory nature, can be applied by contractors and operators to further reduce risk.

Monitor, review the system

Monitor and review the performance of the risk management system (and changes that might affect it). This involves:

- maintaining operator work practices in the form of an explosives management plan;
- having procedures in place to incorporate legislative and other evolving best industry practices into management systems;
- maintaining training programs;
- maintaining a work plan;
- reviewing the effectiveness of the explosives management plan; and
- reviewing incidents and incorporating changes from the lessons learnt.

Communicate and consult with stakeholders

Where appropriate, work with specialists, experts and internal and external stakeholders throughout the risk management process. The stakeholders who are important in the management of the risk should be identified, particularly the 'decision-makers'.

Determining level of risk

The level of risk can be determined using a qualitative risk assessment method, based on appendix E of Australian Standard AS/NZS 4360:2004 *Risk management set*. This involves:

- estimating the levels of consequence and likelihood using Tables A4.1 and A4.2;
- applying the matrix in Table A4.3 to the levels estimated to analyse the risk as 'extreme' (E), 'high' (H), 'medium' (M) or 'low' (L); and
- evaluating the risk against pre-established criteria to determine whether it is 'acceptable'.

The method can be applied to general hazards in the workplace and specific fireworks activities, including design, work practices and procedures (e.g. exposure to noise, flash or exploding fireworks). The results of a risk assessment can be used in conjunction with the control hierarchy to significantly reduce the risk from fireworks-related activities.

The qualitative levels of risk can indicate where to focus efforts for reducing risk to acceptable levels. The person undertaking the risk assessment and reduction strategies should address the highest contributors to risk, namely all E first, followed by H and then M.

The level of risk at L is acceptable. Under certain circumstances, a moderate level of risk may be acceptable risk if the risk has been minimised as low as reasonably practicable. Levels of risk at E and H are not acceptable.

Table A4.1 Qualitative measures of consequence

Description	Example of detailed description
Insignificant	No injuries and low financial loss
Minor	First aid treatment, onsite release immediately contained, medium financial loss
Moderate	Medical treatment required, onsite release contained with outside assistance, high financial loss
Major	Extensive injuries, loss of production capability, offsite release with no detrimental effects, major financial loss
Catastrophic	Death, toxic release offsite with detrimental effect, huge financial loss

Table A4.2 Qualitative measures of likelihood

Likelihood	Description
Almost certain	Expected to occur in most circumstances
Likely	Will probably occur in most circumstances
Moderate	Might occur at some time
Unlikely	Could occur at some time
Rare	May occur only in exceptional circumstances

Table A4.3 Qualitative risk analysis matrix for level of risk

Likelihood	Consequences				
	Insignificant	Minor	Moderate	Major	Catastrophic
Almost certain	H	H	E	E	E
Likely	M	H	H	E	E
Moderate	L	M	H	E	E
Unlikely	L	L	M	H	E
Rare	L	L	M	H	H

E = extreme risk; H = high risk; M = moderate risk; L = low risk

Control measures

The six-element control hierarchy is commonly used in industry and consists of the following measures, described in more detail below:

- elimination (of the hazard);
- substitution (choosing an alternative with a lower hazard and/or less risk);
- isolation (of the hazard);
- engineering (engineering controls to minimise or eliminate the risk);
- administration (administrative controls); and
- PPE.

1. Elimination

Elimination of a risk is always the preferred option but is not always possible. Examples include:

- prohibition of certain types of fireworks (e.g. sky rockets, salutes greater than 75 mm diameter);
- elimination of poor quality fireworks (by introducing a quality management system);
- elimination of certain materials for fireworks equipment (e.g. metal or concrete mortars); and
- elimination of unnecessary confinement of fireworks during events.

2. Substitution

Where a risk cannot be eliminated, other treatments like substitution need to be considered. Examples include:

- substitution of other materials for metal or concrete mortars (e.g. high density polyethylene, fibre reinforced plastic);
- substitution of lower quality fireworks with superior fireworks; and
- substitution of larger, powerful fireworks with a greater number of smaller varieties.

3. Isolation

Even with high order controls in place, incidents may still occur. Hence, minimum clearance distances are set between the fireworks and the viewing public and other areas that need protecting. In addition, operators should be as isolated as possible from the fireworks during firing, and remote electric firing is strongly recommended.

4. Engineering

Engineering controls, such as sand bagging, crowd control barriers, methods of securing fireworks and fireworks equipment, are advocated. Further methods include proper alignment of fireworks in a vertical or known angle position, and properly designing and maintaining items such as mortars, racks and trailers.

5. Administration

Administrative controls (e.g. work procedures and signs) are less likely to be reliable and require constant attention and effective supervision. The contractor should regularly check such controls for compliance.

6. PPE

Personal protective equipment is never a favoured option when using the risk control hierarchy, but it is necessary for operators when the activity at the event cannot be controlled entirely by other means. The nature and type of PPE used is determined by risk assessment. Section 11.4 describes PPE for outdoor events in the absence of other suitable risk control measures.

Selecting risk control measures

It is generally accepted that lower end measures (e.g. PPE) will not be as effective as those at the top of the hierarchy, and that a greater reliance on the lower end reduces control (e.g. isolation of personnel from the firework is a more effective risk control measure than a procedure, sign or PPE). However, it is often necessary to use the lower elements in combination with other controls.

Economic factors affecting control measures

In general, the higher up the hierarchy, the more effective the control measure. While the higher level controls might initially be more costly, they require less managerial effort in the long-term. For example, a design change that eliminates or considerably reduces a hazard only has to be done once.

Supervision, the provision of information, training and PPE require continual maintenance and support, which is usually costly. Hence, the level selected on the hierarchy should take into account the ongoing economic factors in addition to the initial cost of the control measure.

The importance of training depends on the frequency with which the task is performed. In an operational workplace where a task is constantly repeated, training may be considered less important than in a workplace where a task is performed less frequently. Comprehensive training is important to control the risks associated with events and related activities.

Appendix 5 - Default fireworks classification system

UN dangerous goods classification system

The UN classification system for dangerous goods comprises nine classes:

- Class 1 Explosives**
- Class 2 Gases**
- Class 3 Flammable liquids**
- Class 4 Flammable solids**
- Class 5 Oxidising substances**
- Class 6 Toxic and infectious substances**
- Class 7 Radioactive substances**
- Class 8 Corrosive substances**
- Class 9 Miscellaneous dangerous goods**

Explosives in Class 1 are divided into six divisions in accordance with their behaviour when initiated. The class number is combined with the division category to form the hazard division.

Hazard divisions for Class 1 explosives

HD 1.1 Explosives that have a mass explosion hazard and the explosion will result in severe structural damage. The severity and range is determined by the amount of high explosives involved. There may be a risk from heavy debris propelled from the structure in which the explosion occurs.

HD 1.2 Explosives that have a projection hazard but not a mass explosion hazard and the explosion results in items burning and exploding progressively, a few at a time. Furthermore, fragments, firebrands and unexploded items may be projected in considerable numbers; some of these may explode on impact and propagate fire or explosions. Blast effects are limited to the immediate vicinity.

HD 1.3 Explosives that are a fire hazard and either a minor blast hazard or a minor projection hazard or both, but not a mass explosion hazard. This hazard division includes some items that burn with great violence and intense heat emitting considerable thermal radiation (mass fire hazard) and others which burn sporadically. Items in this hazard division may explode but do not usually form dangerous fragments. Firebrands and burning containers may be projected.

HD 1.4 Explosives that present no significant hazard. This hazard division includes items that are primarily a moderate fire hazard but do not contribute excessively to a fire. The effects are largely confined to the package. No fragments of appreciable size or range are to be expected. An external fire does not cause the simultaneous explosion of the total contents of a package of such items; and 1.4S explosives are so designed and/or packaged that any explosive effect during storage and transport is confined within the package, except when an external fire has degraded this packaging. An external fire must not cause instantaneous explosion of the total contents of the package.

HD 1.5 Not applicable to fireworks.

HD 1.6 Not applicable to fireworks.

Determination of mixed hazard divisions

Where explosives from two or more hazard divisions are stored or transported together, the resultant hazard division is determined using Table A5.1. When more than two hazard divisions are involved, this table is used for any two of the hazard divisions and the result is used to repeat the process with the remaining hazard divisions.

For example, the overall hazard division for a storage containing HD 1.2, 1.3 and 1.4 explosives is determined as follows. Taking HD 1.2 and 1.3 and using Table A5.1 results in HD 1.1. The process is repeated using the initial determination of HD 1.1 with the remaining HD 1.4 for a final determination of HD 1.1. Repeating the process in any other order produces the same answer.

Table A5.1 Determination of hazard division for mixed explosives storage and transport

Hazard division	1.1	1.2	1.3	1.4
1.1	1.1	1.1	1.1	1.1
1.2	1.1	1.2	1.1	1.2
1.3	1.1	1.1	1.3	1.3
1.4	1.1	1.2	1.3	1.4

Compatibility groups

Different kinds of explosives may be mixed for storage and transport only if they are compatible. Explosives are considered to be compatible if they can be stored or carried together without significantly increasing either the probability of an accident or, for a given quantity, the magnitude of the effects of such an accident.

Explosives are formally grouped into 13 compatibility groups — A to H, J, K, L, N and S (the letters I and M are deliberately not used).

CG A Primary explosive substance.

CG B Article containing a primary explosive substance and not containing two or more effective protective features. Some articles such as detonators for blasting, detonator assemblies for blasting and primers, cap-type are included even though they do not contain primary explosives.

CG C Propellant explosive substance or other deflagrating explosive substance or article containing such explosive substance.

CG D Secondary detonating explosive substance or black powder or article containing a secondary detonating explosive substance, in each case without means of initiation and without a propelling charge, or article containing a primary explosive substance and containing two or more effective protective features.

CG E Article containing a secondary detonating explosive substance, without means of initiation with a propelling charge (other than one containing a flammable liquid or gel or hypergolic liquids).

CG F Article containing a secondary detonating explosive substance with its own means of initiation, with a propelling charge (other than one containing a flammable liquid or gel or hypergolic liquids) or without a propelling charge.

CG G Pyrotechnic substance, or article containing a pyrotechnic substance, or article containing both an explosive substance and an illuminating, incendiary, tear- or smoke-producing substance (other than a water-activated article or one containing white phosphorus, phosphides, a pyrophoric substance, a flammable liquid or gel, or hypergolic liquids).

CG H Article containing both an explosive substance and white phosphorus.

CG J Article containing both an explosive substance and a flammable liquid or gel.

CG K Article containing both an explosive substance and a toxic chemical agent.

CG L Explosive substance or article containing an explosive substance and presenting a special risk (e.g. due to water-activation or presence of hypergolic liquids, phosphides or a pyrophoric substance) and needing isolation of each type.

CG N Articles containing only extremely insensitive detonating substances.

CG S Substance or articles so packed or designed that any hazardous effects arising from accidental functioning are confined within the package unless the package has been degraded by fire, in which case all blast or projection effects are limited to the extent that they do not significantly hinder or prohibit fire fighting or other emergency response efforts in the immediate vicinity of the package.

Note: Most restricted fireworks come under group G.

Compatible storage

Other dangerous goods must not be stored with explosives, and only explosives that are compatible with each other according to Table A5.2 may be stored together. Compatible fireworks of different hazard divisions may be stored together.

Note: The compatibility requirements for storage differ slightly from those for transport.

Table A5.2 Permitted combinations of compatibility groups for storage

	A	B	C (a)	C (s)	D (a)	D (s)	E	F	G (a)	G (s)	H	J	K	L	N	S
A	✓															
B		✓			✓*		✓*	✓*								✓
C (a)			✓	✓	✓	✓	✓	✓	✓						✓	
C (s)			✓	✓	✓	✓	✓								✓	✓
D (a)		✓*	✓	✓	✓	✓	✓	✓	✓						✓	✓
D (s)			✓	✓	✓	✓	✓									
E		✓*	✓	✓	✓	✓	✓	✓	✓						✓	✓
F		✓*	✓		✓		✓	✓								✓
G (a)			✓		✓		✓		✓							✓
G (s)										✓						✓
H											✓					✓
J												✓				✓
K													✓			
L														✓#		
N			✓	✓	✓		✓								✓	✓
S		✓		✓	✓		✓	✓	✓	✓	✓	✓			✓	✓

Notes:

✓ *Permitted combinations*

□ *Incompatible combinations*

(a) *Explosive article*

(s) *Explosive substance*

Permitted only if explosives are of the same type

* *Permitted only for detonating fuses of group B*

Classification codes

A classification code is a statement of the class, hazard division and compatibility group to which an explosive has been assigned as shown in Figure A5.1. Table A5.3 lists all the codes that are used.

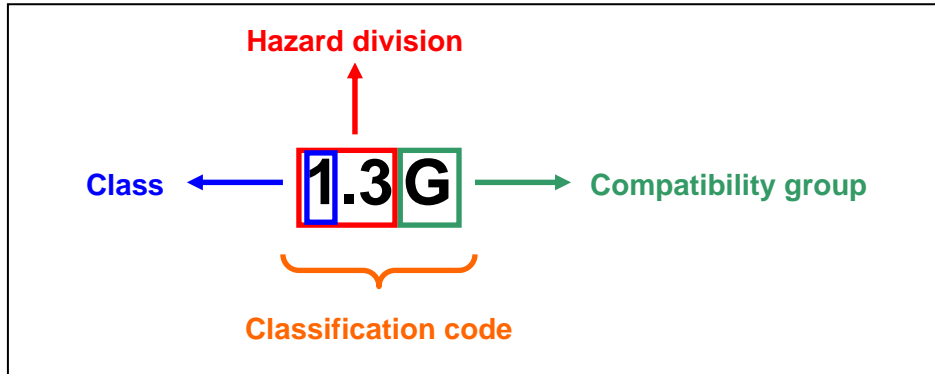


Figure A5.1 Components of explosives classification code

Table A5.3 Classification codes for explosives

	A	B	C	D	E	F	G	H	J	K	L	N	S
HD 1.1	1.1A	1.1B	1.1C	1.1D	1.1E	1.1F	1.1G		1.1J		1.1L		
HD 1.2		1.2B	1.2C	1.2D	1.2E	1.2F	1.2G	1.2H		1.2K	1.2L		
HD 1.3			1.3C			1.3F	1.3G	1.3H	1.3J	1.3K	1.3L		
HD 1.4		1.4B	1.4C	1.4D		1.4F	1.4G						1.4S
HD 1.5				1.5D									
HD 1.6												1.6N	

Default classification of fireworks

The default fireworks classification system adopted here (Table A5.4) is taken from chapter 2.1 of *Recommendations on the Transport of Dangerous Goods. Model Regulations, Volume 1 (14th Revised Edition)*, published by the UN in 2005.

Fireworks are normally assigned to HD 1.1, 1.2, 1.3, and 1.4 on the basis of test data derived from Test Series 6 in *Recommendations on the Transport of Dangerous Goods – Manual of Tests and Criteria (4th Revised Edition)*, published by the UN in 2003. However, since the range of such articles is very extensive and the availability of test facilities may be limited, assignment to a particular hazard division may also be made in accordance with the procedure outlined below.

Assignment of fireworks to UN Numbers 0333, 0334, 0335 or 0336 may be made on the basis of analogy, without the need for Test Series 6 testing, in accordance with Table A5.4. Items not specified in the table must be classified on the basis of test data derived from Test Series 6.

Where fireworks of more than one hazard division are packed in the same package, they must be classified on the basis of the highest hazard division unless test data derived from Test Series 6 indicate otherwise.

Table A5.4 Default fireworks classification

Type	Includes/synonym	Definition	Specification	Classification
Shell, spherical or cylindrical	Spherical display shell: aerial shell, colour shell, dye shell, multi-break shell, multi-effect shell, nautical shell, parachute shell, smoke shell, aerial shell Report shell: maroon, salute, sound shell, thunderclap, aerial shell kit	Device with or without propellant charge, with delay fuse and bursting charge, pyrotechnic unit(s) or loose pyrotechnic composition and designed to be projected from a mortar	All report shells	1.1G
			Colour shell: ≥ 180 mm	1.1G
			Colour shell: < 180 mm with $> 25\%$ flash composition, as loose powder and/or report effects	1.1G
			Colour shell: < 180 mm with $\leq 25\%$ flash composition, as loose powder and/or report effects	1.3G
			Colour shell: ≤ 50 mm, or ≤ 60 g pyrotechnic composition, with $\leq 2\%$ flash composition as loose powder and/or report effects	1.4G
	Peanut shell	Device with two or more spherical aerial shells in a common wrapper propelled by the same propellant charge with separate external delay fuses	The most hazardous spherical aerial shell determines the classification	
	Preloaded mortar, shell in mortar	Assembly comprising a spherical or cylindrical shell inside a mortar from which the shell is designed to be projected	All report shells	1.1G
			Colour shell: ≥ 180 mm	1.1G
			Colour shell: > 50 mm and < 180 mm	1.2G
			Colour shell: ≤ 50 mm, or < 60 g pyrotechnic composition, with $\leq 25\%$ flash composition as loose powder and/or report effects	1.3G
	Shell of shells (spherical) (reference to percentages for shell of shells are to gross mass of fireworks article)	Device without propellant charge, with delay fuse and bursting charge, containing report shells and inert materials and designed to be projected from a mortar	> 120 mm	1.1G

Type	Includes/ synonym	Definition	Specification	Classification
		Device without propellant charge, with delay fuse and bursting charge, containing ≤ 25 g flash composition per report unit, with $\leq 33\%$ flash composition and $\geq 60\%$ inert materials and designed to be projected from a mortar	≤ 120 mm	1.3G
		Device without propellant charge, with delay fuse and bursting charge, containing colour shells and/or pyrotechnic units and designed to be projected from a mortar	> 300 mm	1.1G
		Device without propellant charge, with delay fuse and bursting charge, containing colour shells ≤ 70 mm and/or pyrotechnic units, with $\leq 25\%$ flash composition and $\leq 60\%$ pyrotechnic composition and designed to be projected from a mortar	> 200 mm and ≤ 300 mm	1.3G
		Device with propellant charge, with delay fuse and bursting charge, containing colour shells ≤ 70 mm and/or pyrotechnic units, with $\leq 25\%$ flash composition and $\leq 60\%$ pyrotechnic composition and designed to be projected from a mortar	≤ 200 mm	1.3G
Battery / combination	Barrage, bombardos, cakes, finale box, flowerbed, hybrid, multiple tubes, shell cakes	Assembly including several elements either containing the same type or several types each corresponding to one of the types of fireworks listed in this table, with one or two points of ignition	The most hazardous firework type determines the classification	
Roman candle	Exhibition candle, candle, bombettes	Tube containing a series of pyrotechnic units consisting of alternate pyrotechnic composition, propellant charge and transmitting fuse	≥ 50 mm inner diameter, containing flash composition, or < 50 mm with $> 25\%$ flash composition	1.1G
			≥ 50 mm inner diameter, containing no flash composition	1.2G
			< 50 mm inner diameter and $\leq 25\%$ flash composition	1.3G

Type	Includes/ synonym	Definition	Specification	Classification
			≤ 30 mm. inner diameter, each pyrotechnic unit ≤ 25 g and ≤ 5% flash composition	1.4G
Shot tube	Single shot Roman candle, small preloaded mortar	Tube containing a pyrotechnic unit consisting of pyrotechnic composition, propellant charge with or without transmitting fuse	≤ 30 mm inner diameter and pyrotechnic unit > 25 g, or > 5% and ≤ 25% flash composition	1.3G
			≤ 30 mm inner diameter, pyrotechnic unit ≤ 25 g and ≤ 5% flash composition	1.4G
Mine	Pot-a-feu, ground mine, bag mine, cylinder mine	Tube containing propellant charge and pyrotechnic units and designed to be placed on the ground or to be fixed in the ground. The principal effect is ejection of all the pyrotechnic units in a single burst producing a widely dispersed visual and/or aural effect in the air; or: cloth or paper bag or cloth or paper cylinder containing propellant charge and pyrotechnic units, designed to be placed in a mortar and to function as a mine	> 25% flash composition, as loose powder and/or report effects	1.1G
			≥ 180 mm and ≤ 25% flash composition, as loose powder and/or report effects	1.1G
			< 180 mm and ≤ 25% flash composition, as loose powder and/or report effects	1.3G
			≤ 150 g pyrotechnic composition, containing ≤ 5% flash composition as loose powder and/or report effects. Each pyrotechnic unit ≤ 25 g, each report effect < 2 g; each whistle, if any, ≤ 3 g	1.4G
Fountain	Volcanos, gerbs, showers, lances, Bengal fire, flitter sparkle, cylindrical fountains, cone fountains, illuminating torch	Non-metallic case containing pressed or consolidated spark and flame producing pyrotechnic composition	≥ 1 kg pyrotechnic composition	1.3G
			< 1 kg pyrotechnic composition	1.4G
Sparkler	Handheld sparklers, non-handheld sparklers, wire sparklers	Rigid wire partially coated (along one end) with slow burning pyrotechnic composition with or without an ignition tip	Perchlorate based sparklers: > 5 g per item or > 10 items per pack	1.3G
			Perchlorate based sparklers: ≤ 5 g per item and ≤ 10 items per pack; nitrate based sparklers: ≤ 30 g per item	1.4G

Type	Includes/ synonym	Definition	Specification	Classification
Bengal stick	Dipped stick	Non-metallic stick partially coated (along one end) with slow-burning pyrotechnic composition and designed to be held in the hand	Perchlorate based items: > 5 g per item or > 10 items per pack	1.3 G
			Perchlorate based items: ≤ 5 g per item and ≤ 10 items per pack; nitrate based items: ≤ 30 g per item	1.4G
Low hazard fireworks and novelties	Table bombs, throwdowns, crackling granules, smokes, fog, snakes, glow worm, serpents, snaps, party poppers, bonbons	Device designed to produce very limited visible and/or audible effect which contains small amounts of pyrotechnic and/or explosive composition	Throwdowns and snaps may contain up to 1.6 mg of silver fulminate; snaps and party poppers may contain up to 16 mg of potassium chlorate/red phosphorous mixture; other articles may contain up to 5 g of pyrotechnic composition, but no flash composition	1.4G
Spinner	Aerial spinner, helicopter, chaser, ground spinner	Non-metallic tube or tubes containing gas- or spark-producing pyrotechnic composition, with or without noise producing composition, with or without aerofoils attached	Pyrotechnic composition per item > 20 g, containing ≤ 3% flash composition as report effects, or whistle composition ≤ 5 g	1.3G
			Pyrotechnic composition per item ≤ 20 g, containing ≤ 3% flash composition as report effects, or whistle composition ≤ 5 g	1.4G
Wheel	Catherine wheel, Saxon	Assembly including drivers containing pyrotechnic composition and provided with a means of attaching it to a support so that it can rotate	≥ 1 kg total pyrotechnic composition, no report effect, each whistle (if any) ≤ 25 g and ≤ 50 g whistle composition per wheel	1.3G
			< 1 kg total pyrotechnic composition, no report effect, each whistle (if any) ≤ 5 g and ≤ 10 g whistle composition per wheel	1.4G
Aerial wheel	Flying Saxon, UFO, rising crown	Tubes containing propellant charges and sparks-, flame- and/or noise producing pyrotechnic compositions, the tubes being fixed to a supporting ring	> 200 g total pyrotechnic composition or > 60 g pyrotechnic composition per driver, ≤ 3% flash composition as report effects, each whistle (if any) ≤ 25 g and ≤ 50 g whistle composition per wheel	1.3G
			≤ 200 g total pyrotechnic composition and ≤ 60 g pyrotechnic composition per driver, ≤ 3% flash composition as report effects, each whistle (if any) ≤ 5 g and ≤ 10 g whistle composition per wheel	1.4G

Type	Includes/ synonym	Definition	Specification	Classification
Selection pack	Event selection box, event selection pack, garden selection box, indoor selection box; assortment	a pack of more than one type each corresponding to one of the types of fireworks listed in this table	The most hazardous firework type determines the classification	
Firecracker	Celebration cracker, celebration roll, cracker chain	Assembly of tubes (paper or cardboard) linked by a pyrotechnic fuse, each tube intended to produce an aural effect	Each tube \leq 140 mg of flash composition or \leq 1 g black powder	1.4G
Banger	Salute, flash banger, lady cracker	Non-metallic tube containing report composition intended produce an aural effect	$>$ 2 g flash composition per item	1.1G
			\leq 2 g flash composition per item and \leq 10 g per inner packaging	1.3G
			\leq 1 g flash composition per item and \leq 10 g per inner packaging or \leq 10 g black powder per item	1.4G

Notes:

Taken from table 2.1.3.5.5 of Recommendations on the Transport of Dangerous Goods. Model Regulations, Volume 1 (14th Revised Edition)

Prohibited fireworks as described in Appendix 3 remain prohibited although some come under the scope of this table

Unless otherwise stated, references to percentages are to the mass of all pyrotechnic composition (e.g. rocket motors, lifting charge, bursting charge and effect charge)

'Flash composition' refers to pyrotechnic compositions containing an oxidising substance, or black powder, and a metal powder fuel that are used to produce an aural report effect or used as a bursting charge in fireworks devices

Dimensions in mm refer to:

- *spherical and peanut shells — diameter of sphere of shell*
- *cylinder shells — length of shell*
- *shell in mortar, Roman candle, shot tube firework or mine — inside diameter of tube comprising or containing firework*
- *bag mine or cylinder mine — inside diameter of mortar intended to contain mine*

Classifications only apply to articles packed in fibreboard (cardboard) boxes

Appendix 6 - Sample checklist for fireworks performance test

Name of firework tested		
Manufacturer/brand		
Description		
Supplier	Date of supply	
Consignment identification		
Batch	Sample no.	of
Name of tester	Date of test	
Weather conditions		

Test results

Answer yes or no ('Yes' means the firework passed the test. 'No' means it failed.)

- | | |
|---|--|
| Label contains accurate description, warning and instructions | <input type="checkbox"/> Yes <input type="checkbox"/> No |
| Fireworks composition not escaping from article | <input type="checkbox"/> Yes <input type="checkbox"/> No |
| Easily lit with ignition source | <input type="checkbox"/> Yes <input type="checkbox"/> No |
| Where applicable, fuse burning time | <input type="checkbox"/> Yes <input type="checkbox"/> No |
| Delay to firing of next tube (of multi-tube firework) <5 seconds | <input type="checkbox"/> Yes <input type="checkbox"/> No |
| Article functions without exploding (not applicable for fireworks intending to explode e.g. shells, crackers) | <input type="checkbox"/> Yes <input type="checkbox"/> No |
| Article or firework functions without erratic or unsafe projection or flight | <input type="checkbox"/> Yes <input type="checkbox"/> No |
| Article not likely to cause injury or damage in normal use | <input type="checkbox"/> Yes <input type="checkbox"/> No |
| Article remains stable at rest and while firing | <input type="checkbox"/> Yes <input type="checkbox"/> No |
| No burning matter falling or projected >...m away, and <... m in height | <input type="checkbox"/> Yes <input type="checkbox"/> No |
| Debris other than paper, etc., projected laterally <...m from ignition point | <input type="checkbox"/> Yes <input type="checkbox"/> No |
| Debris other than paper, etc., falls <... m from ignition point | <input type="checkbox"/> Yes <input type="checkbox"/> No |
| No paper, etc. debris weighing > 20 g falls >... m from ignition point | <input type="checkbox"/> Yes <input type="checkbox"/> No |
| Powder weight | <input type="checkbox"/> Yes <input type="checkbox"/> No |

Check and record composition weight (CW):

- Single tube firework: CW
- Single tube or cone fountain: CW
- Multi-tube firework: CW
- Crackers: CW <0.3 g per cracker (black powder) and <50 mg (flash powder)

Comments
Signature of tester

Appendix 7 – Converting freight containers for storage

As outlined below, freight containers may be converted for use as magazines to store 1.3G, 1.4G and 1.4S fireworks. More detailed information is found in Clause 2.3.2.1 of Australian Standard AS 2187.1:1998 *Explosives – Storage, transport and use – Storage*.

Where there is an inconsistency between this guidance and AS 2187.1:1998, either may be used or an equivalent design or method adopted. These are minimum requirements and higher standards are encouraged.

Requirements

A non-collapsible general purpose freight container that complies with requirements of Australian Standard AS/NZS 3711.4:1993 *Freight containers – General purpose containers* may be converted for use as a magazine for the storage of fireworks:

- converted freight containers require no additional cladding where the steel case is at least 2 mm thick;
- floors may be made from galvanised steel at least 2 mm thick or seamless timber;
- where floors are made from galvanised steel, the floor must be covered by timber, rubber matting or a covering of equivalent performance; and
- where magazines are raised more than 300 mm from the ground, the floor must be of galvanised steel or the base clad with galvanised steel at least 2 mm thick.

All floors must be constructed in such a manner as to eliminate any areas where residue may accumulate, and:

- all nail or screws must be recessed and the centres filled; and
- all cracks or joins must be filled or covered.

Where ventilation is desired then the requirements of Clause 2.3.3 of AS 2187.1:1998 must be met, with the following exceptions:

- weather shields for side openings are not less than 2 mm thick;
- the side openings may be straight-through vents;
- side opening must be screened to prevent insects, rodents and foreign matter entering; and
- screens may be made of steel plate 2 mm thick perforated with holes that do not occupy more than 45% of the gross area and are not larger than 3 mm in diameter or another method which delivers equal security.

There must be two locking systems on the doors, one of which must be shrouded. The locks must comply with Australian Standard AS 4145.4:2002 *Locksets – Padlocks* to a level 7 standard.

The magazine must be fully lined to comply with Clause 2.3.2.3 of AS 2187.1:1998. All interior surfaces must be free from exposed ferrous metallic substances. Where the external environmental conditions are likely to cause internal temperature fluctuations that may adversely affect the contents, a shade roof should be provided. Where a shade roof is provided it must be self-draining away from doorways.

Lightning protection is required in accordance with Australian Standard AS/NZS 1768:2007 *Lightning protection* relating to the protection of structures with explosives contents. For modular steel magazines, earthing terminals at diagonal corners are required (refer to Clause 2.1.5 of AS 2187.1:1998).

Lighting in magazines may be either natural or artificial. Electrical fittings and wiring must comply with Australian Standard AS 3000:2007 *Electrical installations* (known as the 'Australian/New Zealand Wiring Rules') for electrical equipment in hazardous locations, satisfy the requirements for hazardous zone classification, and:

- electrical installations inside magazines should be avoided; and
- outside lighting may be arranged to shine through the open door of a magazine.

A sign must be permanently fixed to the magazine door stating 'THIS MAGAZINE IS SUITABLE ONLY FOR THE STORAGE OF 1.3G, 1.4G & 1.4S FIREWORKS'.

The magazine must also have signs with the word 'EXPLOSIVE' in bold red letters at least 75 mm high on a white background and an orange 'class' diamond on the door. Fire fighting equipment must be readily accessible to fight external fires.

Note: Explosives in Compatibility Groups C and G should not be stored in the same magazine.

Appendix 8 – Mortar specifications

This appendix provides guidance for designers and manufacturers on wall thickness and strength of mortars. The information has been sourced from the National Fire Protection Association’s NFPA Code 1123:2006 *Fireworks display*.

Tables A8.1 to A8.3 list wall thicknesses for mortar tubes made of cardboard, HDPE and fibreglass. The thicknesses are not minima but recommendations — experience has demonstrated that mortars function reliably using these specifications. However, designers must still be able to demonstrate the safety, suitability and performance of their designs.

Table A8.1 Adequate cardboard mortar wall thickness (mm)

Mortar internal diameter (mm)	Spherical shell	Cylindrical shell single break	Cylindrical shell two break
50	4.5	6.25	9.25
62.5	4.5	6.25	9.25
75	6.25	6.25	9.25
100	6.25	8.25	12.5
125	7.75	10.5	15.5
150	9.25	12.5	18.75
200	12.5	–	–
250	15.5	–	–
300	18.75	–	–
400	–	–	–

Dash means data not currently available

Table A8.2 Adequate HDPE mortar wall thickness (mm)

Mortar internal diameter (mm)	Spherical shell	Cylindrical shell single break	Cylindrical shell two break
50	3.0	4.25	4.25
62.5	3.0	4.25	4.25
75	3.75	4.25	4.25
100	5.0	5.0	5.0
125	5.0	5.0	5.0
150	7.5	8.0	8.0
200	8.0	–	–
250	8.0	–	–
300	9.25	–	–
300	–	–	–

Dash means data not currently available

Table A8.3 Adequate fibreglass mortar wall thickness (mm)

Mortar internal diameter (mm)	Spherical shell	Cylindrical shell single break	Cylindrical shell two break
50	1.75	2.75	2.75
50	1.75	2.75	2.75
62.5	1.75	2.75	2.75
75	1.75	2.75	2.75
100	2.75	2.75	2.75
125	2.75	2.75	2.75
150	2.75	2.75	2.75
200	6.25	–	–
250	6.25	–	–
300	6.25	–	–
300	–	–	–

Dash means data not currently available

Note: Fibreglass means fibreglass reinforced epoxy

Mortars meeting the recommended specifications in Tables A8.1 to A8.3 are generally believed to have suitable strength. However, if there is reason to doubt the adequacy of a mortar's strength, one possible strength test is to fire the heaviest aerial shell of a given size to be used with a charge of lift powder that is 1.5 times the normal quantity. This approximately doubles the normal stress on the mortar. This test must be done before the mortar is used at an event.

Where there is concern that a mortar is too short to cause an aerial shell to be propelled to a safe altitude, a series of test firings should be conducted. However, it is generally believed that mortars of the lengths specified in Table A8.4 are sufficient. As for the wall thicknesses, the lengths specified are not meant to be used as minimum measurements — they are recommended because they have been shown to produce good results.

Table A8.4 Minimum inside mortar length (mm)

Mortar internal diameter (mm)	Single break shell	Double break shell	Up to 4-break shell
75	375	450	525
100	500	575	675
125	600	700	800
150	700	800	925
200	850	1,000	1,150
250	1,000	1,150	1,350
300	1,150	1,300	1,550

Note: The burst height of aerial shells can vary as a function of factors such as the length of the mortar tube, and clearance between inside the mortar tube wall and aerial shell. The provision of this information by the manufacturer is important to establish realistic clearance distances for the event set up and conducting the event.

Appendix 9 – Shell drift in wind

When fired in ideal conditions (i.e. zero wind speed and zero degrees from the vertical), aerial shells do not have a range of zero metres. They randomly scatter from the firing point due to spin generated when firing and swing produced by the shape of the shell.

Table A9.1 Shell drift (m) at wind speed 0 km/h

Shell diameter	Angle from vertical (degrees)						
	0	5	10	15	20	30	45
50 mm	0	24	48	69	88	120	152
62 mm	0	29	57	82	105	143	179
75 mm	0	33	64	93	119	161	202
100 mm	0	40	79	114	145	197	245
125 mm	0	47	91	132	169	229	284
150 mm	0	53	103	150	191	258	319
175 mm	0	59	114	165	211	285	351
200 mm	0	64	124	180	230	310	382
225 mm	0	73	143	207	264	355	434
250 mm	0	82	159	230	294	396	482

Table A9.2 Shell drift (m) at wind speed 5 km/h

Shell diameter	Angle from vertical (degrees)						
	0	5	10	15	20	30	45
50 mm	13	38	61	83	102	134	163
62 mm	14	43	71	96	119	157	191
75 mm	15	48	79	108	134	176	215
100 mm	15	56	94	130	162	213	259
125 mm	16	63	108	149	186	246	299
150 mm	16	70	120	167	209	275	334
175 mm	16	75	131	183	229	302	366
200 mm	17	81	142	198	248	329	397
225 mm	17	90	160	225	282	374	451
250 mm	16	98	177	249	313	415	500

Table A9.3 Shell drift (m) at wind speed 10 km/h

Shell diameter	Angle from vertical (degrees)						
	0	5	10	15	20	30	45
50 mm	26	51	74	96	116	147	175
62 mm	28	57	85	111	134	171	204
75 mm	29	62	94	123	149	191	228
100 mm	31	71	110	146	178	229	273
125 mm	32	79	124	166	203	262	313
150 mm	33	86	137	184	226	293	350
175 mm	33	92	148	201	246	321	382
200 mm	33	97	159	215	266	346	412
225 mm	33	107	177	242	301	392	467
250 mm	33	115	194	266	331	433	515

Table A9.4 Shell drift (m) at wind speed 20 km/h

Shell diameter	Angle from vertical (degrees)						
	0	5	10	15	20	30	45
50 mm	53	77	102	123	142	173	198
62 mm	56	85	113	140	162	199	227
75 mm	59	92	123	154	179	221	254
100 mm	62	102	141	177	210	261	301
125 mm	64	111	157	199	236	296	343
150 mm	65	119	170	218	261	327	380
175 mm	66	124	182	235	282	356	414
200 mm	66	130	192	250	302	382	444
225 mm	67	140	211	278	336	428	499
250 mm	66	147	228	301	367	470	548

Appendix 10 - Safety distances for electro-explosive devices

Table A10.1 Single source safety distances for electro-explosive devices

Description of equipment	Frequency range	Maximum transmitted power	Safe distance
Radar	> 5 GHz	100 kW peak	500 m
Radar	1 to 5 GHz	6 MW peak 50 kW continuous work	800 m
Radar	0.2 to 1 GHz	6 MW peak 50 kW continuous work	1,500 m
SHF: radio relay	3 GHz	20 W	80 m
VHF: radio relay	0.3 to 3 GHz	20 W	150 m
UHF: fixed installation broadcast	0.3 GHz	5 MW	600 m
UHF: movable (see Notes)	0.3 GHz	50 kW	150 m
VHF: fixed, broadcast	30 to 300 MHz	50 kW	900 m
VHF: movable	30 to 300 MHz	5 kW	150 m
HF: broadcast	3 to 30 MHz	500 kW	1,000 m
MF: broadcast	0.3 to 3 MHz	500 kW	1,000 m
LF: broadcast	30 to 300 kHz	500 kW	500 m
VLF: broadcast	<30 kHz	200 kW	100 m
Mobile radio	Any frequency	100 to 500 W	40 m
Mobile radio	Any frequency	10 to 100 W	20 m
Mobile radio	Any frequency	<10 W	Do not make contact with aerial
High frequency ovens (provided there is no significant radio frequency leakage)			No hazard outside oven
Civil aircraft equipment. All types at maximum permitted power			50 m

Notes:

1. *If there are two or more significant transmitting sites radiating powers in excess of 50 kW, each within 3,000 metres (see note 2) of the hazarded firing site, a detailed site assessment should be undertaken*
2. *Tabled distances do not necessarily apply to transmitters using 'troposcatter'*
3. *Distances apply directly in the case of standard commercial igniters with leads unwound or partially unwound during normal handling and when connected into firing circuits. Distances are from the transmitter to the nearest point of the proposed firing circuit*
4. *Table may require amendment as more information on radiation sources becomes available*
5. *'Movable' implies vehicle-borne equipment that requires erection of a portable aerial for operation*
6. *'Mobile' implies capable of operation while vehicle is moving (seagoing vessel radios should not be assumed 'mobile' in this context)*
7. *VHF transmitters at airports may exceed the maximum transmitter powers listed in this table and require special consideration*

Appendix 11 - Securing fireworks

Table A11.1 Matrix of methods for securing fireworks before firing check where the end

Type of firework item and application		Mthd 1	Mthd 2	Mthd 3	Mthd 4	Mthd 5	Mthd 6	Mthd 7	Mthd 8	Mthd 9	Other
Mortars, single	Earth	A	A			B				B	Rack or bucket
	Sand					B				A	Rack or bucket
	Hardstand								A	A	Rack or bucket
	Barges						A		A		Rack, bucket or skip full of sand
	Trailers						A		A		Rack or bucket
Mortars in racks	Earth		A						A		
	Sand		A			B			A		At least 600 mm into ground
	Hardstand								A		Timber feet
	Barges						A			A	Timber feet, skip full of sand
	Trailers						A				
Flares, strobes	Earth	A	B								
	Sand	A	B								
	Hardstand							A			Ply panels
	Barges							A			Ply panels
	Trailers							A			Ply panels beside trailer
Fountains	Earth	A	B								
	Sand	A	B			B					
	Hardstand							A	A	A	Ply panel, rack or bucket
	Barges							A	A	A	Ply panel, rack or bucket
	Trailers							A	A	A	Ply panel, rack or bucket

Type of firework item and application		Mthd 1	Mthd 2	Mthd 3	Mthd 4	Mthd 5	Mthd 6	Mthd 7	Mthd 8	Mthd 9	Other
Candles	Earth	A	A						A		Rack and minimum two stakes
	Sand		A			B			A		Rack and minimum two stakes
	Hardstand								A		Rack with timber feet
	Barges							A	A		Rack with timber feet
	Trailers							A	A		Rack with timber feet
Unstable cakes	Earth		A	A							Minimum two stakes
	Sand		A	A							At least 300 mm into ground and minimum of two stakes
	Hardstand			A							
	Barges			A							
	Trailers			A							
Stable cakes	Earth		A	A							At least 150 mm in ground and minimum two stakes
	Sand		A	A							At least 300 mm into ground minimum two stakes
	Hardstand			A				A			Ply panels
	Barges			A				A			Ply panels
	Trailers			A				A			Ply panels

Type of firework item and application		Mthd 1	Mthd 2	Mthd 3	Mthd 4	Mthd 5	Mthd 6	Mthd 7	Mthd 8	Mthd 9	Other
Wheels	Earth				A						A 75 mm x 100 mm timber post, purpose designed attachment, post secured by star-pickets
	Sand				A						A 75 mm x 100 mm timber post, purpose designed attachment, post secured by star-pickets
	Hardstand				A						A 75 mm x 100 mm timber post, purpose designed attachment, post secured by brackets
Wheels (mounted)	Barges				A						A 75 mm x 100 mm timber post, purpose designed attachment, post secured by brackets
	Trailers				A						A 75 mm x 100 mm timber post, purpose designed attachment, post secured by brackets

Matrix key

A *First choice for securing item*

B *Second choice or additional measure for extra security needed, such as sandbags or barriers*

Table A11.2 Description of methods for securing fireworks items

Method number	Brief description	Notes
Method 1	Stake and tape and/or tie wire	Single stake of appropriate length, and several turns of strong wide adhesive tape. Item to be rigidly immobilised.
Method 2	Multiple stake and tape	As for the above but using more than one stake, includes staking racks.
Method 3	Box	Box with wide stable base with or without sandbags. Item to be rigidly immobilised within box using pins, tape, brackets or wedges.
Method 4	Purpose built support	75 mm x 100 mm timber post, purpose designed attachment, post secured by star-pickets.
Method 5	Burial	Burial to depth, or sandbagging sufficient to immobilise item.
Method 6	Bolt to frame	Rack or box bolted to frame in case of trailer mounting.
Method 7	Ply panels	Secure to horizontal ply panels using tape and screws, or brackets. Item to be rigidly immobilised.
Method 8	In rack	Mount in rack, secure rack by staking or sand bagging.
Method 9	In bucket or bin	Mount in self supporting bucket or skip-bin full of sand and item to be buried almost to full depth.

Note: The methods for securing fireworks described in this matrix are not meant to be comprehensive. Alternative methods of securing fireworks may be available, and if they offer better security, they should be used.

Terminology:

Barges — Floating launch vessels including pontoons

Barrier — Solid wall able to physically separate item and its effects in event of worst-case malfunction from audience

Box — Wooden or plastic container large enough to contain item and to direct all effects upwards in event of worst-case malfunction

Earth — Ground solid enough to accept and hold steel rod stake. Stake must be able to anchor item rigidly with no lateral or upward movement possible

Hardstand — Ground or surface too hard to accept stakes

Sand — Ground not solid enough to accept stake as above

Sand bags — Unrestrained sand should not be used to secure items. Sand must be bagged or contained (e.g. box, tub, skip, trench, plywood panels)

Staking — Preferably steel rod or hardwood. Exposed stake not to protrude above item, driven sufficiently deep to fix item rigidly with no lateral movement possible

Taping — Heavy duty adhesive tape, at least 25 mm wide. Gaffer tape, packaging tape, duct tape, fibre reinforced tape. Multiple turns required, item must be rigidly held

Trailers — Towed or four wheeled vehicle holding racks of mortars

Unstable cakes — Multishot items with centre of gravity above one-third item height

Zip ties — Plastic zip ties should not be used to secure any fireworks item

Appendix 12 – Common fireworks malfunctions

Table A12.1 Common malfunctions in aerial shells

Malfunction	Common causes	Action
Premature ignition – shell fires from mortar before it is intentionally lit	Burning debris in the mortar or sparks from neighbouring articles	Cover loaded mortars with aluminium foil for prevention
Hangfire – shell fuse suddenly starts burning slower than it is supposed to. Just as suddenly, it may resume burning at its normal rate	Fuse wet or damaged	Wait at least 30 minutes before you attempt to remove the shell from the mortar
Misfire – shell does not fire	Article wet or damaged	Warn shell loader not to use the mortar in which the misfire occurred for the duration of the event When event is over, clear the mortar and dispose of the shell Place tape on mortar to indicate presence of unfired shell
Mortar burst – shell explodes inside the mortar	Fire leak into the shell Weak or damaged casing Stars reacting to loading impact Time fuse damaged or missing	Discontinue event until inspection of immediate area in which malfunction occurred proves conditions to be safe
Muzzle break – shell bursts just as it leaves the mortar, scattering stars and burning material in all directions near ground level	Faulty manufacture Time fuse damaged or missing	Discontinue event until inspection of immediate area in which malfunction occurred proves conditions to be safe
Low (ground) break – shell explodes on or near the ground, either on the way up or coming down	Shell misloaded into oversized mortar Insufficient lifting charge Damaged or missing plug Damaged time fuse	Discontinue event until inspection of immediate area in which malfunction occurred proves conditions to be safe
Dud Shell – shell rises but fails to burst at the proper height and falls to the ground, sometimes igniting or exploding on landing	Faulty manufacture Damaged time fuse or primer	Recover and dispose of dud shell
Burning debris – shell burst at right altitude but shell components fall to the ground as burning or live pieces	Damp stars or components Shell break too powerful Burst ignites non-fireworks material	Recover and dispose of components

Table A12.2 Common malfunctions in Roman candles

Malfunction	Common causes	Action
Low burst – burning projectiles fall to the ground	Article wet or damaged	Discontinue event until inspection of immediate area in which malfunction occurred proved conditions to be safe