GunSmoke Canada

www.gunsmoke.ca

ERD-Authorised Pyrotechnics Safety and Legal Awareness Course

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DISCLAIMER

GunSmoke Canada (Gun-Smoke International Inc) is authorised by the Explosives Regulatory Division (ERD) of Natural Resources Canada (NRCan) to present this Special Effect Pyrotechnics Safety and Legal Awareness Course.

The core content of the course is designated by ERD.

In this course GunSmoke Canada & Mark Fine are not offering training in the use of Special Effect Pyrotechnics.

We are merely providing Safety and Legal Awareness information and product information about the use of Special Effects Pyrotechnics in Canada, as directed by ERD, and some anecdotes to illustrate the information.

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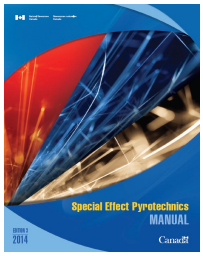
Special Effects Pyrotechnics Manual

- Available on – line at:
  www.gun-smoke.ca/copy-of-about



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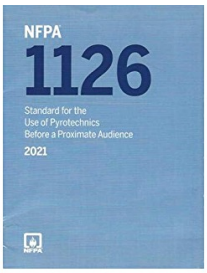
National Fire Protection Association



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Course Topics

1. Regulators: NRCan / ERD / CERL
2. List of Authorized Explosives
3. Explosives Regulations, 2013
   Part 17 Special Effect Pyrotechnics
4. Types of Pyrotechnics
5. Supervision of a Pyrotechnic Event
6. Transportation of Pyrotechnics
   Part 9 Transportation
   Transportation of dangerous goods (TDG)
7. Packaging and Safety Marks
8. Final Steps - **Test and Evaluation**

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Natural Resources Canada (Federal Government Department)

- Natural Resources Canada (NRCan) seeks to enhance the responsible development and use of Canada's natural resources (including mining) and the competitiveness of Canada's natural resources products.
- NRCan is an established leader in science and technology in the fields of energy, forests, and minerals and metals and use their expertise in earth sciences to build and maintain an up-to-date knowledge base of our landmass.

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Explosives Regulatory Division

- Located within NRCan, the Explosives Regulatory Division (ERD) is responsible for administering Canada's *Explosives Act* and *Regulations*.
- ERD operates with two main goals in mind: first, to ensure public safety; and second, to strengthen national security.
- The National Fireworks Certification Program is administered by ERD.

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Canadian Explosives Research Laboratory

- CanmetCERL (Canadian Explosives Research Laboratory) is the only Canadian government laboratory dealing with commercial explosives, and one of the few in the world.
- CanmetCERL routinely tests special effect pyrotechnics to determine their suitability for the Canadian market.

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Explosives Regulations, 2013

- ER, 2013 came into force on February 1st, 2014
- 20 Parts
  - *Part 9 – Transporting Explosives*
  - *Part 14 – Small Arms Cartridges, Propellant Powders & Percussion Caps*
  - *Part 17 – Special Effect Pyrotechnics*

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Categories of Explosives

- ***F - Fireworks***
- Consumer Fireworks F.1
- Display Fireworks F.2
- ***Special Effects Pyro F.3***
- ***Fireworks Accessories F.4***

- ***P - Propellants***
- ***Black Powder P.1***
- ***Smokeless Powder P.2***

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List of Authorized Explosives

- All special effects pyrotechnics in Canada must be authorized and listed on the List of Authorized Explosives.
- The List contains the following details for each explosive:
  - The name of the company (or person) who obtained the authorization;
  - The trade name and classification of the explosives; and
  - Any restrictions imposed by the Chief Inspector of Explosives

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List of Authorized Explosives

- The list is available on the website:
https://eservices.nrcan-rncan.gc.ca/web/elms-esml/

- Or, search for "**list of authorized explosives**" using a search tool like Google.

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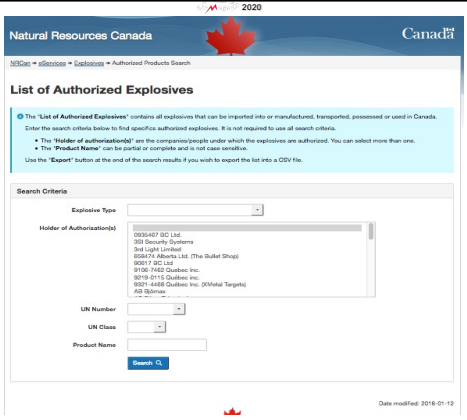

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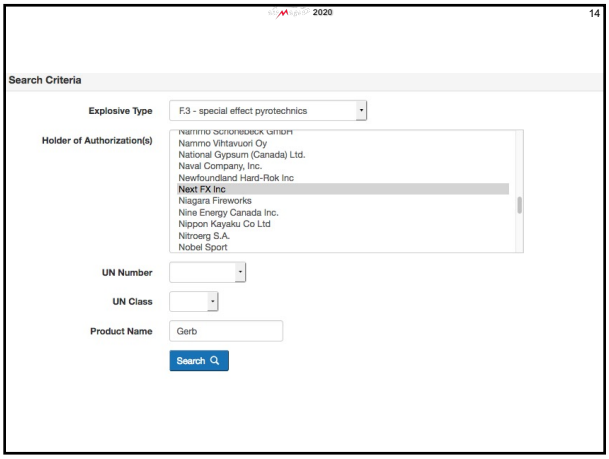

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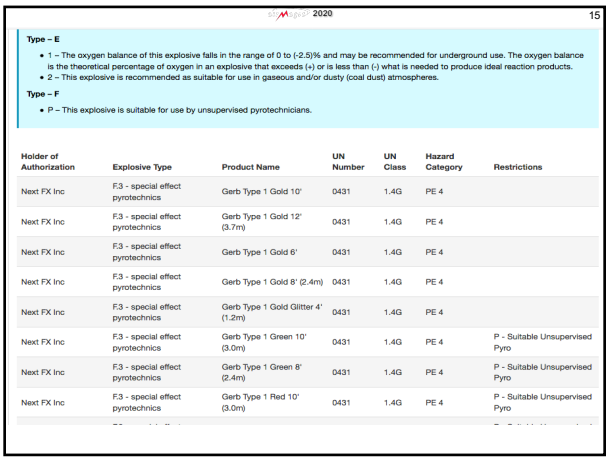

Type – E

- 1 – The oxygen balance of this explosive falls in the range of 0 to (-2.5)% and may be recommended for underground use. The oxygen balance is the theoretical percentage of oxygen in an explosive that exceeds (+) or is less than (-) what is needed to produce ideal reaction products.
- 2 – This explosive is recommended as suitable for use in gaseous and/or dusty (coal dust) atmospheres.

Type – F

- P – This explosive is suitable for use by unsupervised pyrotechnicians.

Holder of Authorization	Explosive Type	Product Name	UN Number	UN Class	Hazard Category	Restrictions
Next FX Inc	F.3 - special effect pyrotechnics	Gerb Type 1 Gold 10'	0431	1.4G	PE 4	
Next FX Inc	F.3 - special effect pyrotechnics	Gerb Type 1 Gold 12' (3.7m)	0431	1.4G	PE 4	
Next FX Inc	F.3 - special effect pyrotechnics	Gerb Type 1 Gold 6'	0431	1.4G	PE 4	
Next FX Inc	F.3 - special effect pyrotechnics	Gerb Type 1 Gold 8' (2.4m)	0431	1.4G	PE 4	
Next FX Inc	F.3 - special effect pyrotechnics	Gerb Type 1 Gold Glitter 4' (1.2m)	0431	1.4G	PE 4	
Next FX Inc	F.3 - special effect pyrotechnics	Gerb Type 1 Green 10' (3.0m)	0431	1.4G	PE 4	P - Suitable Unsupervised Pyro
Next FX Inc	F.3 - special effect pyrotechnics	Gerb Type 1 Green 8' (2.4m)	0431	1.4G	PE 4	P - Suitable Unsupervised Pyro
Next FX Inc	F.3 - special effect pyrotechnics	Gerb Type 1 Red 10' (3.0m)	0431	1.4G	PE 4	P - Suitable Unsupervised Pyro

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"P" Pyrotechnics

- Explosives that are classified as type F.3 and whose use by Pyrotechnicians or Visitor Pyrotechnicians has been authorized by the Chief Inspector of Explosives; as well as all fireworks accessories.
- These articles will be designated in a column in the list of Authorized Explosives by the letter "P".
- If the type F. 3 pyrotechnic article has the letter "P" in the column then the holder of a FOC – Pyrotechnician or Visitor can use the pyrotechnic article unsupervised.

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License vs. Certificate

Businesses
Magazine License – Import License
Manufacturing License

Individuals
Fireworks Operators Certificate (FOC)
Special Effects Pyrotechnics – Display Fireworks

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Special Effect Pyrotechnics

VS.

Special Purpose Pyrotechnics

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Special Effect Pyrotechnics

- Special Effects Pyrotechnics (pyrotechnics) are classified in ER, 2013 as:
  - Type F.3 explosives;
  - Fireworks accessories type F.4 (i.e. electric matches);
  - Black Powder (type P.1) and Smokeless Powder (type P.2);
  - Initiation systems (type I)
  - Detonating cord (type E.1); and
  - Low Hazard special purpose explosives (Type S.1) and high-hazard special purpose explosives (Type S.2)

    S.1 – e.g.: Road Flares; Smoke products

    S.2 – e.g.: Binary explosives; Tannerite

Reference: ER, 2013 S.361

Special Purpose Pyrotechnics

- Special Purpose Pyrotechnics are Special Effect Pyrotechnics that are combined with a flammable liquid, solid or gas to produce custom-made special effects

Reference: ER, 2013 S.361

AHJ
Authority Having Jurisdiction

Local Authority – In relation to special effects pyrotechnics: the municipal, provincial or territorial organization or office that has authority to authorize the use of special effect pyrotechnics in a locality.

Typically the Fire Prevention Office

of the Local Fire Department

Reference: ER, 2013 S.6 (3)

Fireworks Operator Certificate (FOC)

Five (5) types of certificates available:

1. Pyrotechnician
2. Senior Pyrotechnician
3. Special Effects Pyrotechnician
4. Special Effects Pyrotechnician - detonating cord
5. Visitor Pyrotechnician

Reference: SPFX Manual, 1.1

Qualifications

- Pyrotechnician– a person must successfully complete the pyrotechnics safety and legal awareness course offered by ERD or a course *certified* as equivalent by NRCan.

Reference: ER, 2013 S.387 (1)

Applying for Pyrotechnician F.O.C.

- Application to Obtain Fireworks Operator Certificate
  - name, date of birth, address, telephone number, and email address;
  - proof that you have successfully completed the pyrotechnics safety and legal awareness course offered by the Explosives Regulatory Division, Department of Natural Resources or a course certified as equivalent by the Minister of Natural Resources.

Reference: ER, 2013 S.388 (1)

Visitor Pyrotechnician

- Visitor Pyrotechnician - a person must reside outside Canada and have the necessary experience using special effect pyrotechnics to safely carry out the activities of a holder of a fireworks operator certificate (Pyrotechnician).

Reference: ER, 2013 S.387 (5)

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Applying for Visitor Pyrotechnician

- Application to obtain Fireworks Operator Certificate – Visitor
  - name, date of birth, address, telephone number, and email address;
  - the name of any organization of pyrotechnicians you belong to;
  - ***a copy of your resumé that sets out the events in which you have used pyrotechnics and the people and organizations for which you have worked;***
  - ***a list of the pyrotechnic events in which you plan to participate while in Canada and the dates of the events; and***
  - ***the name, telephone number and number of the fireworks operator certificate of the pyrotechnician in charge at each event in which you plan to participate.***

Reference: ER, 2013 S.388 (5)

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Use – Pyrotechnician & Visitor Pyrotechnician

- A Pyrotechnician (or Visitor Pyrotechnician) may use:
  - explosives that are classified as type F.3 and whose use by pyrotechnicians or visitor pyrotechnicians has been authorized – "P"
  - all fireworks accessories;
  - smokeless powder;
  - explosives classified as type F.3 other than "P", AND black powder, but only under the direct supervision of a senior pyrotechnician or special effects pyrotechnician;
  - special purpose pyrotechnics, but only under the direct supervision of a special effects pyrotechnician; and
  - initiation systems and detonating cord, but only under the direct supervision of a Special Effects Pyrotechnician Detonating Cord.

Reference: ER, 2013 S. 399

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Use – Visitor Pyrotechnician

- A Visitor Pyrotechnician may use:
  - explosives that are classified as type F.3 and whose use by pyrotechnicians or visitor pyrotechnicians has been authorized – "P"
  - all fireworks accessories;
  - smokeless powder;

BUT

  - A Visitor Pyrotechnician must be under the direct supervision of a Senior Pyrotechnician or Special Effects Pyrotechnician or Special Effects Pyrotechnician w/Detonating Cord, depending on the effects that will be used in the production, concert or film shoot.

Reference: ER, 2013 S. 399

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Keep a Log or Work Journal

You must keep a work journal that includes

- the date and place of each pyrotechnic event you work and the types of explosives used
- the capacity in which you act at each pyrotechnic event
- the name of the supervisor at each pyrotechnic event

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To Apply – Renew or Upgrade

You must use the ERD Electronic Licence Management System (eLMS) for your initial certification, and for renewing and upgrading.

We have put up an easy to follow "How To" guide for applying for & renewing your ERD certification in the Resources menu on the Gun-Smoke.ca Website.

http://www.gun-smoke.ca/copy-of-about

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Fees

- Initial Certification is $102.00.
- Upgrade or add endorsements is $102.00.
- Renewal is $102.00.

- Payable by certified cheque, money order, or credit card (Visa or Mastercard).

- Note – All certificates expire five (5) years from date of issue.

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Digital Fireworks Operator Certificates are here!

As of **January 1st, 2022,** plastic photo ID cards will no longer be issued

When you submit an application for your fireworks operator certificate online using the electronic Licence Management System (eLMS), you will be able to download, save and print your certificate directly from eLMS.

Sending applications by snail mail?

Certificates will not be emailed.

You will receive a paper copy of the certificate by mail.

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Qualifications Senior Pyrotechnician

- Senior Pyrotechnician – a person must have acted as a Pyrotechnician for at least a year and must be able to use explosives that have been classified as type F. 3 and propellant powders.

Reference: ER, 2013 S.387 (2)

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Use – Senior Pyrotechnician

- A user who holds an FOC (fireworks operator certificate) Senior Pyrotechnician may use:
  - explosives classified as type F.3, fireworks accessories, black powder and smokeless powder;
  - special purpose pyrotechnics, but only under the direct supervision of a special effects pyrotechnician; and
  - initiation systems and detonating cords, but only under the direct supervision of a certified Special Effects Pyrotechnician — Detonating Cord

Reference: ER, 2013 S. 400

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Qualifications Special Effects Pyrotechnician

- Special Effects Pyrotechnician– a person must have acted as a Senior Pyrotechnician for at least a year and must be able to safely use explosives that are classified as type F.3, propellant powders and special purpose pyrotechnics.

Reference: ER, 2013 S.387 (3)

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Use – Special Effects Pyrotechnician

- A user who holds an FOC Special Effects Pyrotechnician may:
  - assemble at the site of use and use special purpose pyrotechnics, explosives classified as type F.3, fireworks accessories, black powder, smokeless powder; and
  - initiation systems and detonating cords, but only under the direct supervision of a Special Effects Pyrotechnician Detonating Cord.

Reference: ER, 2013 S. 401 (1)

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Qualifications Special Effects Pyrotechnician w/Detonating Cord

- Special Effects Pyrotechnician with Detonating Cord - a person must have an FOC Special Effects Pyrotechnician and must be able to safely use initiation systems and detonating cords.

Reference: ER, 2013 S.387 (4)

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Use – Special Effects Pyrotechnician with detonating cord

- A user who holds an FOC Special Effects Pyrotechnician with Detonating Cord may:
  - assemble at the site of use and use special purpose pyrotechnics, explosives classified as type F., fireworks accessories, black powder, smokeless powder; and
  - use initiation systems and detonating cords.

Reference: ER, 2013 S. 401 (2)

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Applying for Senior Pyrotechnician, Special Effects Pyrotechnician or Special Effects with Detonating Cord

- Application for Modification of Fireworks Operator Certificate
  - a copy of the applicant's work journal that sets out…
    - ***the date and place of each pyrotechnic event at which the applicant has worked and the types of explosives used,***
    - ***the capacity in which the applicant acted at each pyrotechnic event,***
    - ***the name of the applicant's supervisor at each pyrotechnic event***

Reference: ER, 2013 S.388 (3)

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Additional Information and Documentation

- Senior Pyrotechnician - Establish that you have acted as a Pyrotechnician for a year and submit ***a letter from a supervisor*** which attests that you are able to safely use type F.3 explosives and propellant powder;
- Special Effects Pyrotechnician - establish that you have acted as a Senior Pyrotechnician for a year & submit ***a letter from a supervisor*** which attests that you are able to safely use type F.3 explosives, propellent powder and special purpose pyrotechnics.
- Special Effects Pyrotechnician — detonating cord), establish that you have acted as a Special Effects Pyrotechnician for a year and submit a ***letter from a supervisor*** which attests that you are able to safely use initiation systems and detonating cords.

Reference: ER, 2013 S.388 (4)

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Exemptions #1

Users without a Licence or a Certificate may purchase, store and use…

Flash Cotton
Flash Paper
Flash String
Sparkle String

Storage

No more than 200g of Flash Cotton, 1 kg Flash Paper, 200g Flash String & 200g Sparkle String may be stored at any one time.

Reference: Manual, 2014 S. 1.2

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Exemptions #2 – Re-enactments

Users without a Licence or a Certificate may purchase, store and use… Percussion Caps & Propellant Powder

IF the caps and powder are purchased for the use of original or reproduction firearms (including cannons) in a historical re-enactment.

You **MUST** have ***written consent of the local AHJ***, and have ***experience in the safe use of explosives in re-enactment,*** and have ***completed a course certified by the Minister of Natural Resources*** or be under the supervision of someone who has experience and has completed such a course.

Reference: Manual, 2014 S. 1.2.2

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Eye Protection

- ALWAYS wear Eye Protection when handling pyrotechnics
- Even Matches!!!!
- There are NO exceptions!
- Rated Z87+

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Eye Protection

- Z87+ glasses must pass "high mass" tests
- Dropping a 500 gram pointed weight from a height of about 5 feet onto the lens.
- Shooting a ¼" steel ball at the lens, velocity varies.
  Glasses = 102 mph from a distance of 150′
  Goggles = 170 mph from a distance of 250′

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Surface Area

The more surface area exposed to the flame
The faster or more robust it will burn

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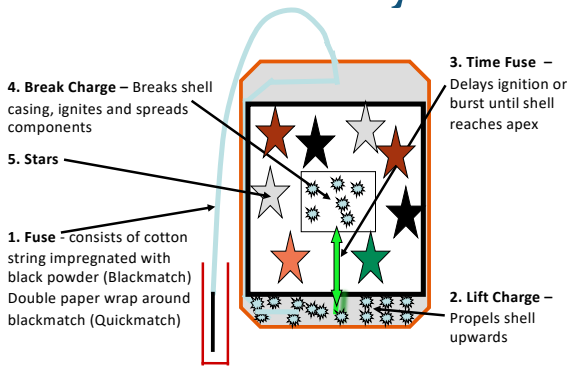
Lift Theory



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Electric Matches

- A device used to cause the ignition of pyrotechnic materials.
- It consists of two wires terminating at the bridge wire coated or surrounded with a small quantity of heat-sensitive pyrotechnic composition.
- When a sufficient current is passed through the wire, the heat generated ignites the composition, producing a small flame or spark.

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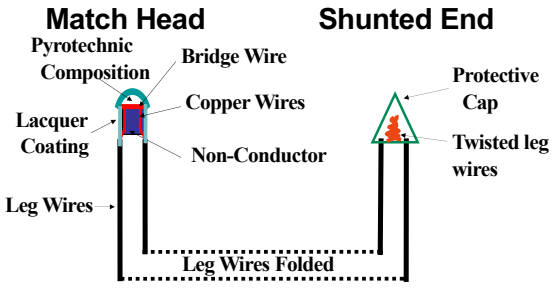
Electric Matches



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Electric Matches - Shunts

- Electric matches are **extremely sensitive** to…
- Impact
- Friction
- Electrostatic discharge
- RF

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Styles of Shunts

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Video – Electric Matches:

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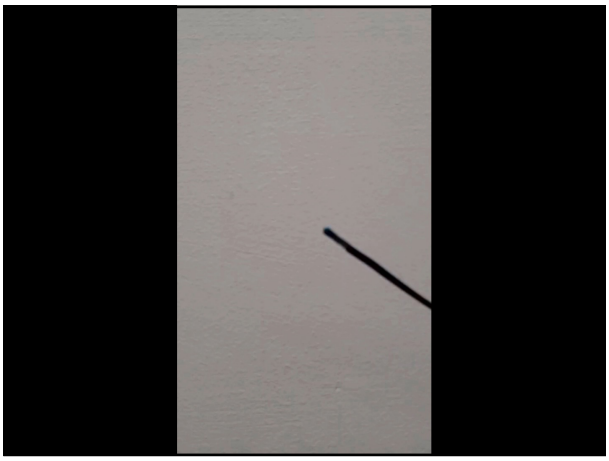

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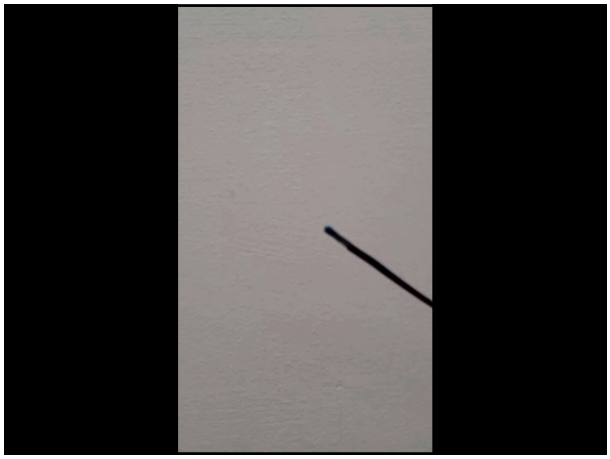

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Nitrocellulose Products

- **Flash Paper**
- **Flash String**
- **Sparkle String**
- **Flash Cotton**
- **Ice Fountains**
- **Smokeless Gunpowder**

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Videos – Nitrocellulose:

- Flash Paper
- Flash String
- Sparkle String
- Flash Cotton
- Ice Fountain
- Smokeless Powder
- Ball Powder

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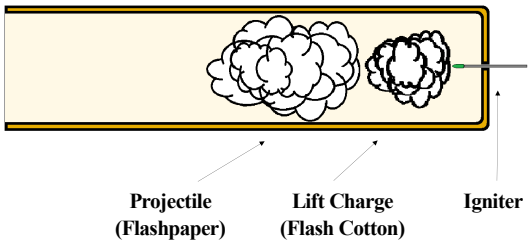
Flashpaper Shooter



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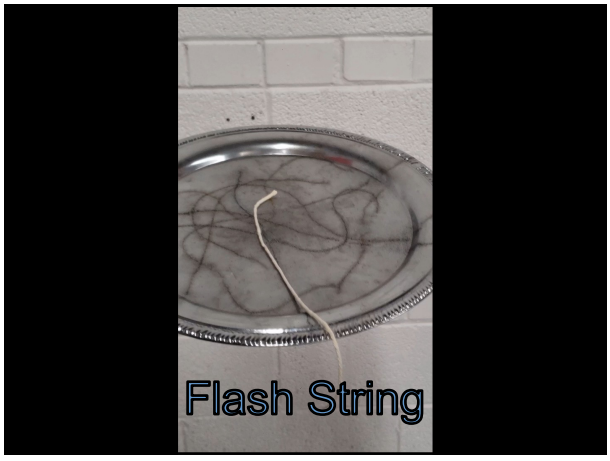

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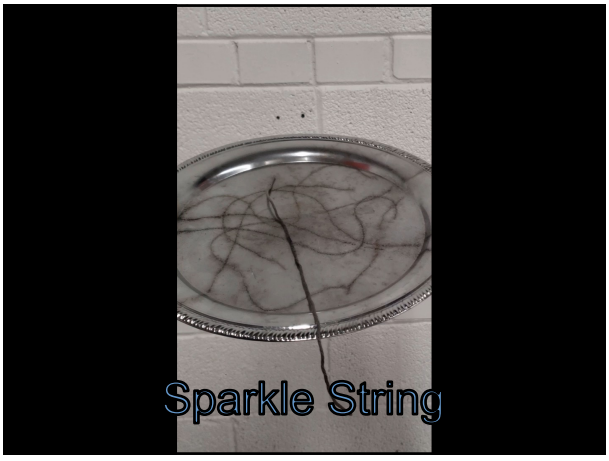

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Braided Sparkle String - MasterChef Canada

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Pyro Sign – Horizontal Ice Fountains

Ice Fountain Centre Piece

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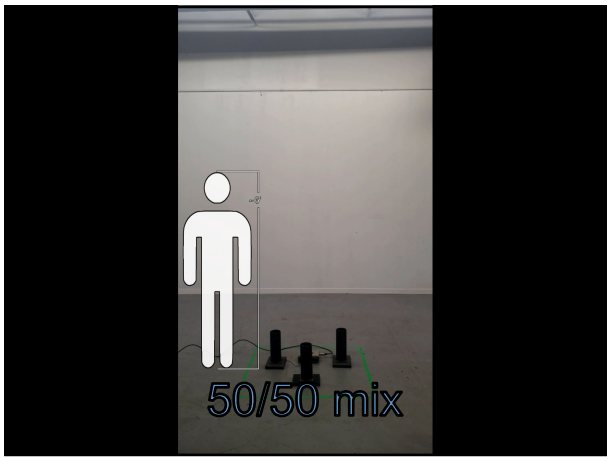

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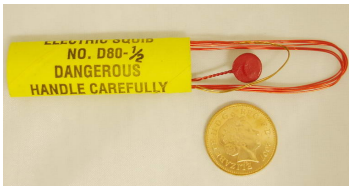
Bullet Hits



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Brass Bullet Hit Shields

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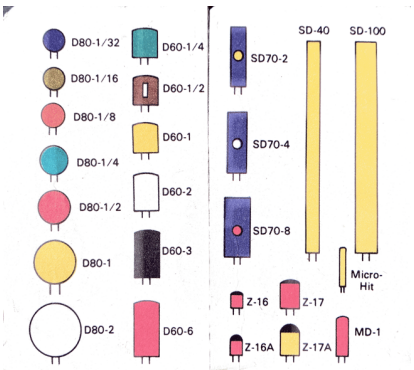
De La Mare Bullet Hit Chart



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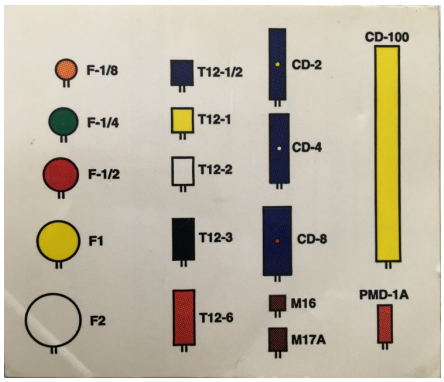
MP Associates Bullet Hit Chart



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Gun Flash / Microdets / Robotics

SPDs - Spark Producing Devices

(DSC - Direct Shorting Cap)

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Video – Spark Effects:

- Gunflash – LeMaitre
- ¼ S.P.D. – Ultratec
- Robotic – Ultratec
- Airburst Robotic - Ultratec

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LeMaitre Gunflashes – Brodsky & Baryshnikov

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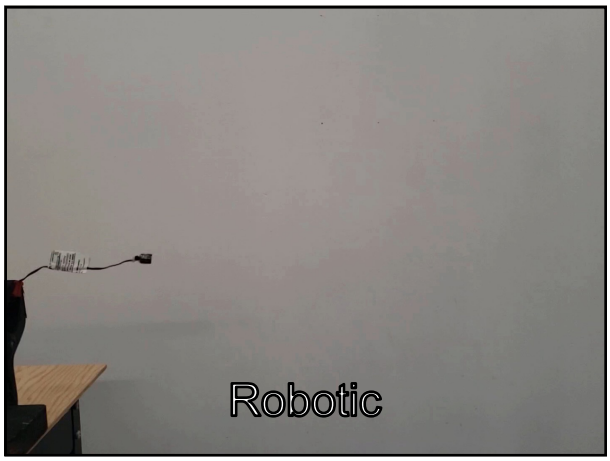

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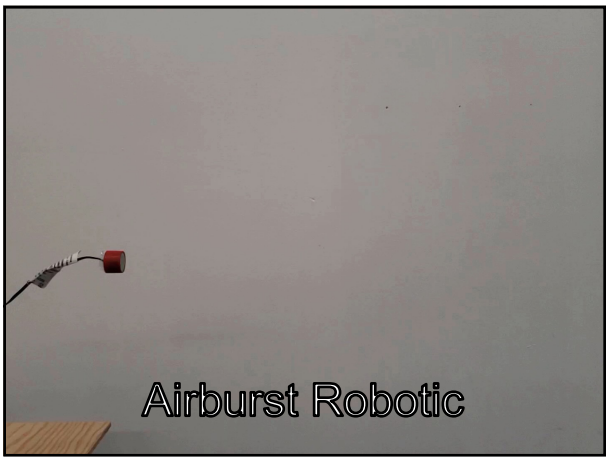

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Theatrical Flash

- A device containing Flash Powder intended to produce a flash of light and/or sparkles

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A/B Flash Powders

"Two-Component"

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A/B Caps

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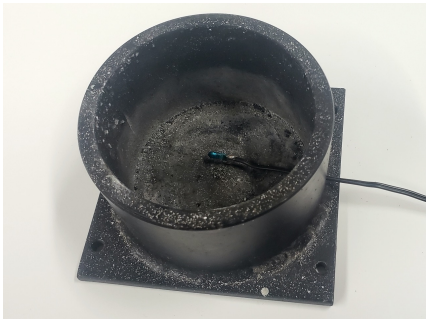
Flashpot



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Video – Flash:

- Regular Flash Powder (2 cap)

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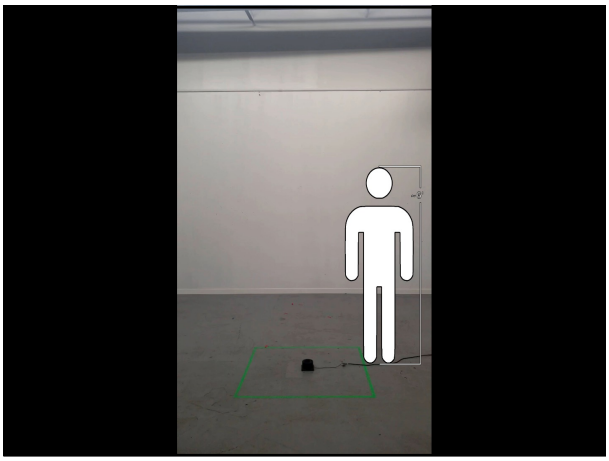

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Video - Mortar Hits:

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Gowan - Triumph induction to Walk of Fame

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Smoke Effects

- A device – usually a cartridge.
- When initiated it produces a quantity of smoke – either White or Coloured.
- Note – Coloured smoke cartridges use pigments that may stain wardrobe and scenery

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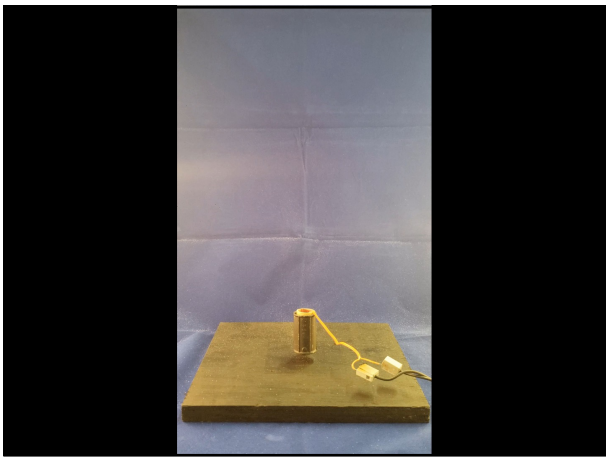
Videos – Smoke:

- Mrs. Potts Type III (Beauty & The Beast Musical)
- 90s Smoke Emitter – Enola Gay

91



92

93

Blue Smoke - MasterChef Canada

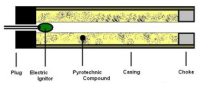
94

Gerbs

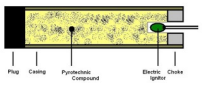
- An article consisting of a short, heavily walled tube filled with pressed pyrotechnic composition.
- It is usually equipped with a choke intended to produce a controlled jet or broad spray of sparks.

95

Short Duration



Long Duration



96

2020 97

Gerbs

Short Duration

Long Duration

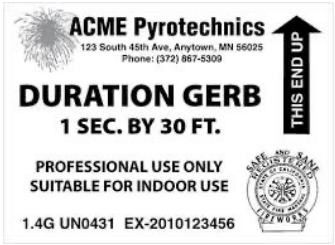
97

2020 98

Gerb Press

98

2020 99



99

Plastic Gerb Caps

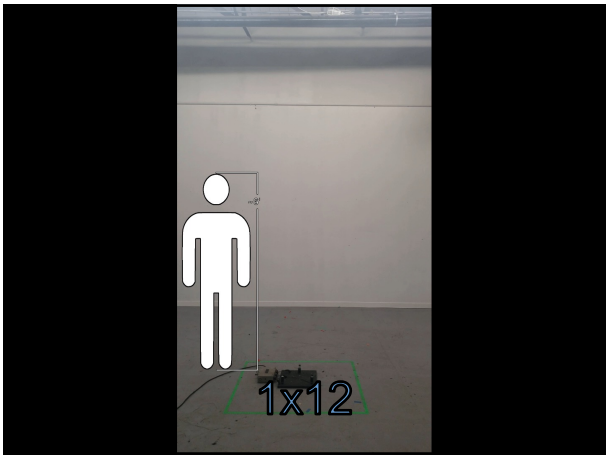
100

2020 101

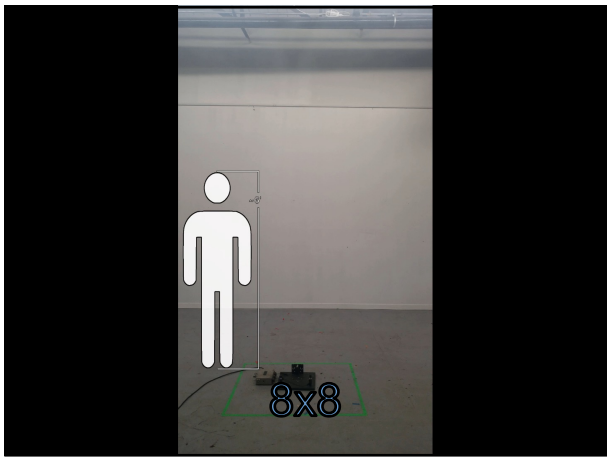
Videos – Gerbs:

- 1x12 – Ultratec
- 8x8 - Ultratec
- 10x10 Red – Angelfire
- 8x8 Waterfall - Ultratec

101



102

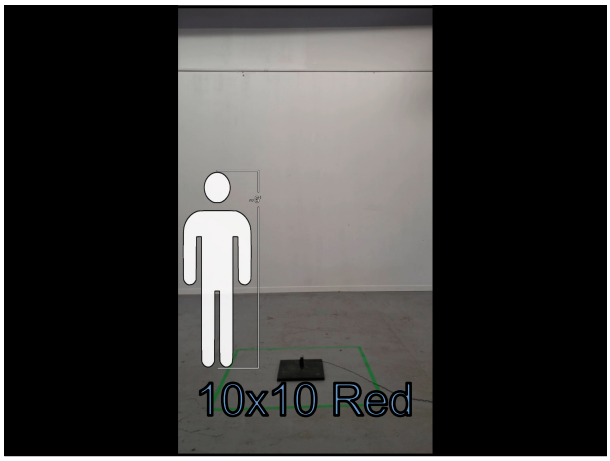


103

8 x 8 Gerb Demo

1 x 25 Gerbs – Toronto Raptors

104



105

106

Gerb Waterfalls - Arkells – Tim Hortons Field

107

Videos – Colin Furze:

- Gerbs on set piece

108

109

110

Saxon

111

Video – Saxon:

112

Pyropak Saxon

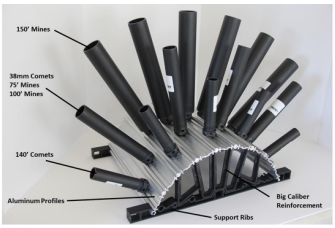
ultratec special effects inc.

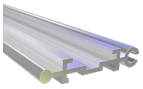
113

Close Proximity Pyrotechnics "Close-Prox"

114

Pyro Lamas





115

Comets

- Comet – a device that projects one large star of pyrotechnics composition that produces a stream of sparks or fire (long-tailed effect) as the effect is projected to elevation

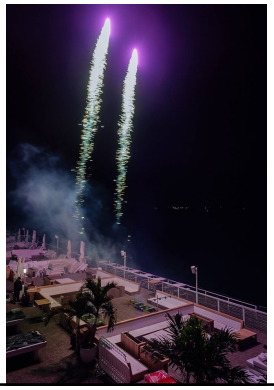
116

Video - Comets:

117

118

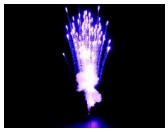
250' Comets – Rebel Nightclub



119

Mines

- Mine – a device that projects many small stars of pyrotechnics composition that produces streams of sparks or fire (long-tailed effect) as the effects are projected to elevation



120

Video – 200' Mines:

121

Mines 200ft

A-B

With Lift Disc

VS

Without Lift Disk

ultratec special effects inc.

122

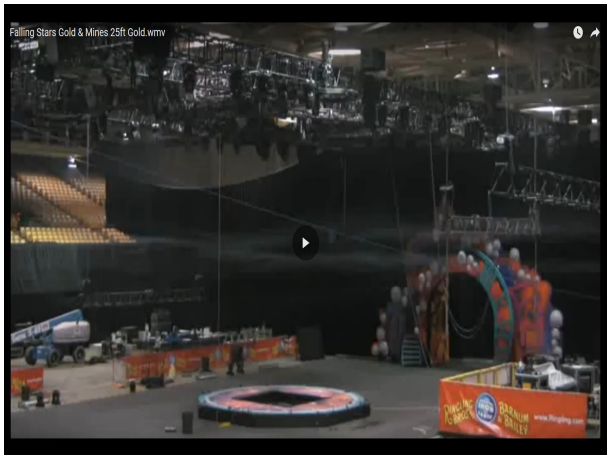
Next FX Mines 100 – 250' Gold Glitter

123

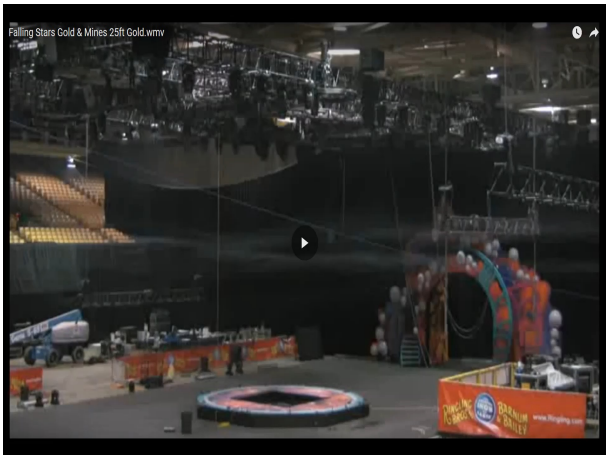
Video – Ringling Bros:

- Falling Stars
- Gold Mines

124



125



126

2020 127

Airbursts

- An airburst is an effect suspended in the air to simulate outdoor aerial fireworks shells without producing the same hazardous debris.

127

2020 128

Videos - Airburst:

- **Regular Airburst (1 cap)**

128

129

2020 130

Airbursts - MTCC

130

2020 131

Video - Concert Pyro:

- **Flame Projectors**
- **Mortar Hits**
- **Tracer Comets**
- **Mines**
- **Airbursts**

131

132

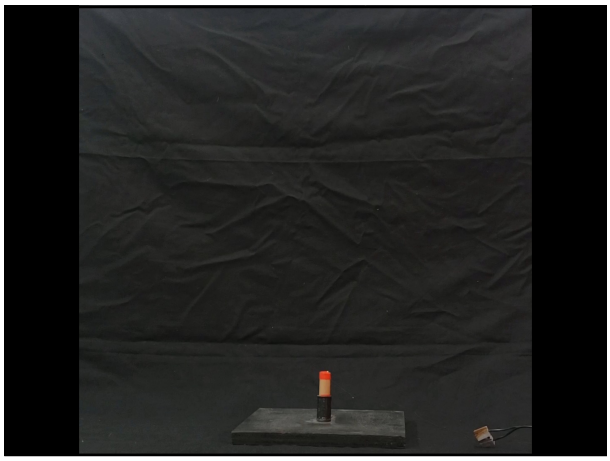
Flares – Wheel of Death

133

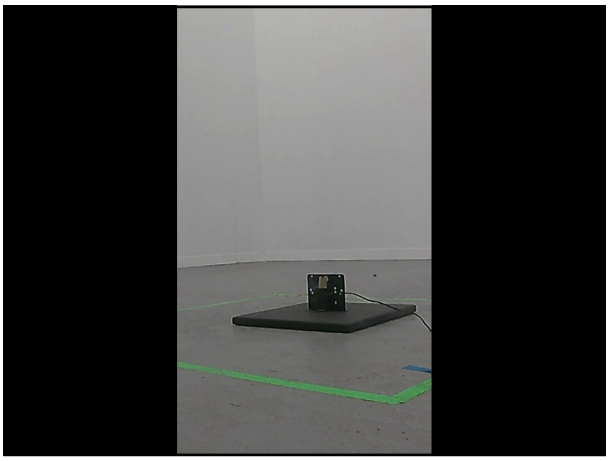
Videos – Flare:

- 18s White Flare - MP Associates
- Gandalf Staff – 30s White
  (Lord of the Rings Musical)

134



135



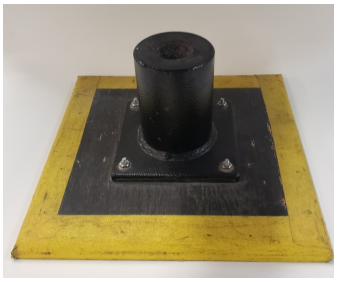
136

Concussion / Maroon

- A device containing pyrotechnic composition that produces a loud report sound.

137

Steel Concussion Mortars

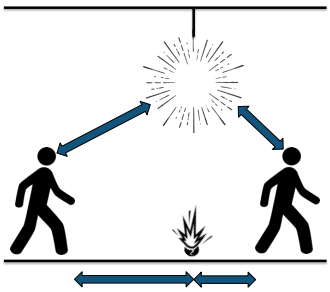


138

Distances

- To establish the distance from the pyrotechnics to the audience you use the greatest of the following distances:
  - 5 m – 15 (16.4) feet;
  - The distance recommended by the manufacturer, or;
  - Twice the distance of the fallout radius of the pyrotechnic.
- Performer's distance – Safe Distance
  - The distance recommended by the manufacturer, or;
  - Twice the distance of the pyrotechnic fallout radius

Safe Distance Considerations



- Orientation to effect
- Clothing & Hairstyle
- Scenery & nearby items

Concussion Mortar Distances

- Concussion mortars must be well secured, separated from the audience, performers and support personal by 8 m – 25' (26.2') and barricaded (where required, to guard against shrapnel).

Manufacturer's instructions

- The manufacturer's instructions for setting up and firing the special effect pyrotechnics must be followed.

Firing Unit

- Only the pyrotechnician in charge, or a person designated by the pyrotechnician in charge, may have access to the firing unit.

Reference: ER, 2013 S. 406 (2)

Physical Keying Device

- The pyrotechnician in charge, or a person designated by the pyrotechnician in charge, must have control of any physical keying device at all times.

Reference: ER, 2013 S. 406 (3)

Safety Interlock

- The firing unit must be equipped with a safety interlock that has at least two steps.

Reference: ER, 2013 S. 406 (4)

145

Device attached to body

- Any device that is used to contain special effect pyrotechnics and is hand-held or attached to a person's body must be equipped with a firing system that has two switches.

Reference: ER, 2013 S. 406 (6)

146

Extraneous Electricity

- Precautions that minimize the likelihood of extraneous electricity igniting an electric match must be taken.
  - i.e. - Shunting the leads of the electric match

Reference: ER, 2013 S. 406 (5)

147

Connecting to a power supply

- A firing unit must not be connected to a power supply except during a test of circuit continuity or immediately before a special effect pyrotechnic is to be fired. The circuit continuity tester must be current-limited and intrinsically safe so as to eliminate the possibility of an ignition of any pyrotechnic.

Reference: ER, 2013 S. 406 (7)

148

Continuity

DSL
Demolition Safety Light

149

Devices

- Any device that is used to contain special effect pyrotechnics must be:
  - designed and manufactured to prevent fragmentation or distortion of the device;
  - designed and manufactured to prevent or contain fragmentation of the pyrotechnics;
  - mounted so as to prevent any change in position or direction when used;
  - positioned and secured in a manner that minimizes the likelihood of harm to people and property; and
  - maintained in good condition.

Reference: ER, 2013 S. 406 (8)

150

Damaged Pyrotechnics

- Special effect pyrotechnics that are damaged, leaking, damp or contaminated must not be used.

Reference: ER, 2013 S. 406 (9)

151

Film and Television Effects

- Special Purpose Pyrotechnics
- Detonating Cord – a round, flexible cord with an outer braid textile wrap and inner explosives of PETN (pentaerythritol tetranitrate) or RDX (cyclotrymethylenetrinitiramine).
  - Cord diameters range from 3 to 15 mm, with core loads ranging from 1 to 85g, respectively.

152

Video - Film Pyro:

- **Special Purpose Pyrotechnics**
- **Detonating Cord**

153

154

Gross Mass vs. N.E.Q.

Gross Mass:

The total weight of an explosive including any wiring, packaging or container.

N.E.Q.
(**N**et **E**xplosive **Q**uantity)
(a.k.a. **N**et **E**xplosive **C**ontent)

The weight of only the explosive material or compound.

155

Acquisition and Storage

- A user may acquire and store special effect pyrotechnics, whether or not they hold a licence, if they hold the fireworks operator certificate required for use of the pyrotechnics to be acquired.
- However, a user who does not hold a licence must not acquire initiation systems or detonating cords. A user who acquires special effect pyrotechnics must comply with Explosives Regulations Part 17, subdivision C.

Reference: ER, 2013 S.389

156

Storage – Maximum Quantity

- A user who does not hold a licence must store their special effect pyrotechnics in a dwelling or a storage unit.
- No more than 500 electric matches and 25 kg of other special effect pyrotechnics may be stored at any one time.

Reference: ER, 2013 S.391 and S.392

157

Black Powder / Smokeless Powder

- Smokeless powder must be stored in its original container or in small arms cartridges.
- Black powder must be stored in its original container, in small arms cartridges or in black powder cartouches.

Reference: ER, 2013 S.393

158

Quantity of Propellant Powder

- **Detached Dwelling**: The maximum quantity of propellant powder that may be stored at any one time in a detached dwelling, or in a storage unit attached to a detached dwelling, is 25 kg of which no more than 10 kg may be black powder.
- **Other Dwellings**: The maximum quantity of smokeless powder that may be stored at any one time in a dwelling other than a detached dwelling, or in a storage unit that is attached to a dwelling other than a detached dwelling, is:
  - 20 kg, if all the smokeless powder is in containers that hold no more than 1 kg; or
  - 10 kg, if any of the smokeless powder is in a container that holds more than 1 kg.

Reference: ER, 2013 S.394 and S.395

159

Quantity of Black Powder

- The maximum quantity of black powder that may be stored at any one time in a dwelling other than a detached dwelling, or in a storage unit that is attached to a dwelling other than a detached dwelling, is
  - 1 kg, if the black powder is in containers; and
  - 3 kg less any quantity that is in containers, if the black powder is in small arms cartridges or black powder cartouches.

Reference: ER, 2013 S.395 (2)

160

Detached storage unit

- The maximum quantity of propellant powder that a user may store at any one time in a storage unit that is not attached to a dwelling, whether in a single unit or in several, is 75 kg.

Reference: ER, 2013 S. 396

161

Storage Requirements - Dwelling

- When special effects pyrotechnics are stored in a dwelling, they must be stored away from flammable substances and sources of ignition, in a manner that protects the pyrotechnics from theft and ensures that access to them is limited to people authorized by the user.

Reference: ER, 2013 S.397

162

Storage Unit Requirements

Special effect pyrotechnics stored in a storage unit;

- The storage unit must be located in a dry place, away from flammable substances and sources of ignition;
- The storage unit must be constructed and maintained to prevent unauthorized access and to protect the contents from weather;
- If the storage unit is a container, it must not impede exit in case of fire;
- If the storage unit is not a container, all exits must be kept unobstructed;
- Any shelving in the storage unit must be made from a non-sparking material (for example, wood or painted metal);
- Nothing other than explosives classified as Type F may be stored in the storage unit; ...

Reference: ER, 2013 S.397 (2)

Storage Unit Requirements, cont.

- electric matches must be stored separately from other explosives (for example, on different shelves or separated by a wooden partition);
- the storage unit must be attended when it is unlocked;
- the storage unit must be kept clean, dry, organized and free of grit;
- any spill, leakage or other contamination in the storage unit must be cleaned up immediately;
- precautions that minimize the likelihood of fire in or near the storage unit must be taken; and
- a sign that displays the words:

  "Danger — Fire Hazard/Risque d'incendie"

  in letters at least **10 cm** high and that prohibits smoking using letters, or a symbol, at least 10 cm high must be posted on the storage unit in a clearly visible location.

Reference: ER, 2013 S.397

Storage Requirements for site of use

- The storage unit must be made from, or lined with, a non-sparking material, marked with the words "Pyrotechnics/Pièces pyrotechniques" and kept locked, away from flammable substances and sources of ignition ***in an area that is not accessible to the public.***
- Nothing other than special effect pyrotechnics may be stored in the storage unit.

Reference: ER, 2013 S. 398 (3)

Storage for site of use

- ~~5 kg of special effects pyrotechnics~~
- ~~Of the 5 kg that may be stored, no more than 3 kg may be propellant powder~~

- Storage limit at site of use 25 kg
- Since the storage is in a controlled access area, the public is not at risk

Reference: ER, 2013 S. 398 (3)

Storage of Detonating cords and Detonators

- If you are purchasing and using detonating cord and detonators, you must hold a licence as well as an FOC – SPFX with detonating cord.

Reference: ER, 2013 S. 368 (2)

Pyrotechnics to be Attended

- Special effect pyrotechnics must be attended when they are not in a storage unit or a magazine.

Reference: ER, 2013 S. 398 (5)

Supervision of a Pyrotechnic Event

Danger Zone

- A danger zone must be established, taking into account the properties of the special effect pyrotechnics to be used, how they will be positioned, the manufacturer's instructions, the weather conditions if the pyrotechnic event is to be held outdoors and the likelihood of harm to people or property resulting from the use of the pyrotechnics.

Reference: ER, 2013 S. 404

Establishing the Danger Zone

- To establish the distance from the pyrotechnics to the audience you use the greatest of the following distances:
  - 5 m – 15 (16.4) feet
  - The distance recommended by the manufacturer
  - Twice the distance of the fallout radius of the pyrotechnic
- Performer's distance – Safe Distance
  - The distance recommended by the manufacturer or
  - Twice the distance of the pyrotechnic fallout radius

Danger Zone - Concussion Mortars

- Concussion mortars must be well secured, separated from the audience, performers and support personal by 8 m – 25' (26.2') and barricaded (where required, to guard against shrapnel).

Danger Zone - Special Purpose Pyrotechnics

- Red Zone – Prohibited access
  - Off limits or closed location – only pyrotechnicians allowed in the Red Zone while the charge is being prepared or placed
  - **Distance (m) = 7 x quantity $^{1/3}$ (kg)**
- Shatter Zone – Window breakage
  - Shatter Zone delineates the area in which the overpressure is sufficient to break residential windows
  - **Distance (m) = 65 x quantity $^{1/3}$ (kg)**
- Green Zone – General protection
  - For protection against shrapnel, fragments or projected material that can be propelled much farther than the actual blast perimeter
  - **Distance (m) = 120 x quantity $^{1/3}$ (kg)**

Fire Prevention and First Aid

- During the pyrotechnic event, fire prevention measures that minimize the possibility of harm to people or property must be put in place and facilities, equipment and personnel for fire fighting and administering first aid that minimize the possibility of harm must be present at the site.

Reference: ER, 2013 S. 405

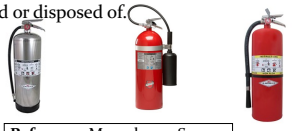
Fire Extinguishers – At Least...

- Two Pressurized Water Class 2A (2.5-gallon)

AND

Two Class 10-BC (20lb CO_2)

- Located within 15m (50') of pyrotechnics and equipment;
- Maintained in accordance with: *NFPA 10; Standard for Portable Fire Extinguishers;*
- All Pyrotechnicians are trained to use the fire extinguishers;
- Fire extinguishers remain on site until all pyrotechnics have been fired, stored or disposed of.



Reference: Manual, 2014 S. 4.5.2

175

No Smoking

- Smoking must be prohibited in the danger zone.

Reference: ER, 2013 S. 402 (4)

176

Flammables

- The danger zone must not contain any flammables or other items that are likely to catch fire.

Reference: ER, 2013 S. 404 (2)

177

Pyrotechnician in Charge

- Every organizer of a pyrotechnic event must ensure that the event is supervised by a pyrotechnician in charge.

Reference: ER, 2013 S. 402 (1)

178

Responsibilities

- The pyrotechnician in charge must ensure that the event is carried out safely and that the requirements of ER. 2013 - sections 403 to 408 are complied with.

Reference: ER, 2013 S. 402 (2)

179

- 403 – Event Plan
  - Information to be included
  - Submit to AHJ
  - Safety Meetings
- 404 – Danger Zone
  - Establish Zone
  - No Flammables
  - Only authorized people
  - No Smoking
- 405 – Fire Prevention & First Aid

180

- 406
  - Follow Manufactures Instruction
  - Access to Firing Unit
  - Key Control
  - Safety Interlocks
  - Minimize Extraneous Electricity (Shunts)
  - Two switches with handheld devices
  - Connection to Power Supply only when…
  - Integrity of Holders
  - Do Not use damaged, leaking etc.
  - Do not fire if…
  - Postpone or stop if…

181

- 407 –After Firing
  - Immediately disconnect firing unit from power
  - Do not approach misfires until…
  - Take precautions
  - Inspect site
  - No one unauthorized may enter site until…
- 408 – Record of the Event
  - Logbook

182

Permit Application Checklist

- Name & Certification of the Supervising Pyrotechnician
- Names & Certification of any other Pyrotechnicians
- Drawing showing location of pyro, participants, distances to audience, exits, & fire extinguishers
- List of Fire Extinguishers, Fire Blankets & First Aid kits supplied
- Letter of permission from the venue
- Insurance certificate naming the Municipality as co-insured
- List of the types and manufacturers of the effects you propose to use
- Proof the pyro is on the Authorized List
- Dates of the first and last public performances
- Day and time, before the first public performance, when the Fire Department can inspect.
- Firing order and type of firing system
- Any other relevant information
- Risk Assessment

183

Our Risk Assessments

We start by making a number of guarantees:

- We will have Fire Extinguishers that meet or exceed the requirements;
- Fire extinguishers will be located close to effects and spotters;
- Our staff are trained in the use of Fire Extinguishers;
- We will have Fire Blankets and a First Aid kit;
- Our staff are First Aid trained and certified;
- Our operator will be in line of sight of the effects OR
- There will be video cameras with monitors for the operator;
- There will be a spotter – in contact with the operator;
- Staff will have Clearcom or Radios to be able to communicate;
- All hardware and effects comply w/ERD regs and NFPA 1126;
- All hardware will be robust and prevent accidental re-direction;
- Control system is purpose built and has a key lockout;
- We will have a phone to call 911 if required.

184

Our Risk Assessments – cont'd

- After making these promises, we conclude…
- All effects are secured and at safe distances from audience and performers;
- We may name certain effects and their specific distances;
- Therefore……. The Risk Level is Low!

185

Plan

- A pyrotechnic event plan must be prepared in writing and kept for two years after the date of the pyrotechnic event. The plan must include the following information:
- The name of the pyrotechnician in charge and the number and expiry date of their fireworks operator certificate;
- A description of the site of the event, including the placement of the special effect pyrotechnics, the proximity of the audience and the location of every exit, every storage area for the pyrotechnics and every smoke detector that may be triggered by the pyrotechnics used in the event;

Reference: ER, 2013 S. 403 (1)

186

Plan – cont'd

The type and trade name of each special effect pyrotechnic that will be used and name of the manufacturer that obtained its authorization;

A description of each special effect pyrotechnic;

- the anticipated height, duration and fallout effect of the effects of each special effect pyrotechnic;
- a description of the anticipated effects of each special purpose pyrotechnic;
- the method and sequence of firing the special effect pyrotechnics; and
- an assessment of the likelihood of harm to people or property resulting from the use of the special effect pyrotechnics.

Reference: ER, 2013 S. 403 (1)

187

Approval

- The plan must be submitted to the AHJ. The written approval of the local authority to hold the pyrotechnic event must be obtained before the event takes place.

Reference: ER, 2013 S. 403 (2)

188

Safety Meetings

- Meetings must be held with the people who will participate in presenting the pyrotechnic event (for example, security guards, artists and technicians) to inform them of the special effect pyrotechnics that will be used and the safety precautions to be taken during the event. Subsequent meetings must be held if the event is changed in a way that increases the likelihood of harm to people or property resulting from the use of the pyrotechnics.

Reference: ER, 2013 S. 402 (3)

189

Access

- Only people authorized by the pyrotechnician in charge may enter or be in the danger zone from the time any special effect pyrotechnics are brought into the zone until the pyrotechnician in charge declares the zone to be free of explosives.

Reference: ER, 2013 S. 404 (3)

190

No Firing

- A special effect pyrotechnic must not be fired if a circumstance occurs that could increase the likelihood of harm to people or property.

If it feels unsafe – <u>Do Not Fire</u>

Reference: ER, 2013 S. 406 (10)

191

Postponing or stopping event

- A pyrotechnic event must be postponed or stopped if unfavourable weather conditions develop (outdoor use), a special effect pyrotechnic malfunctions, or any other circumstance occurs that could increase the likelihood of harm to people or property.

Reference: ER, 2013 S. 406 (11)

192

Firing Unit Disconnected

- The firing unit must be disconnected immediately after the pyrotechnic event, as well as during a pause in the event if keeping the unit connected could increase the likelihood of harm to people or property. When a unit is disconnected, any physical keying device must be removed and kept in the possession of the pyrotechnician in charge or a person designated by the pyrotechnician in charge.

Reference: ER, 2013 S. 407 (1)

193

Misfired Pyrotechnics

- Misfired special effect pyrotechnics must not be approached until at least:
  - one minute after firing, if the firing was initiated by an electric match; and
  - 30 minutes after firing, if the firing was initiated by other means.
  - Precautions that minimize the likelihood of harm to people and property from **misfired special effect pyrotechnics** must be taken.

Reference: ER, 2013 S. 407 (2)

194

Search / Cleanup

- As soon as the circumstances permit, the site of the pyrotechnic event must be searched and all explosives must be removed from the site.

Reference: ER, 2013 S. 407 (4)

195

Access

- After the event, only people designated to do a search by the pyrotechnician in charge may enter or be in the danger zone until the pyrotechnician in charge declares the zone to be free of explosives.

Reference: ER, 2013 S. 407 (5)

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Disposal

- You must obtain a division 2 factory licence or manufacturing certificate if you want to dispose of special effect pyrotechnics.
- Please contact ERD for further information.
- If you function the pyrotechnic as intended, this is not considered disposal.

Reference: ER, 2013 S. 107 (l)

197

Reporting Incidents

A holder of a licence, permit or **certificate** must inform an inspector as soon as the circumstances permit of any of the following incidents that involves an explosive under their control:

- the theft, attempted theft or loss of an explosive;
- a fire, spill or accidental explosion;
- an injury or death; or
- any accidental property damage.

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Logbook of Events

- A record of the pyrotechnic event must be made in a logbook that sets out the name of the pyrotechnician in charge and the number and expiry date of their fireworks operator certificate. The logbook must be kept for two years after the date of the last recorded event. The record must include the following information and documents:
  - a copy of the pyrotechnic event plan prepared for the event;
  - a copy of the AHJs approval to hold the event;
  - the name and address of every person who worked at the event under the supervision of the pyrotechnician in charge; and
  - a description of any unusual circumstance, a statement of the number of misfires and a description of how each misfire was dealt with.

Reference: ER, 2013 S. 408

199

Record of Licence holder

- When a pyrotechnic event is held on behalf of a licence holder, the holder must keep a record of the event for two years after the date of the event. The record must include the following information and documents:
  - the licence holder's name and address and the number and expiry date of their licence;
  - the name of the pyrotechnician in charge and the number and expiry date of their fireworks operator certificate;
  - a copy of the local authority's approval to hold the event;
  - the type and trade name of each special effect pyrotechnic used and the name of the person who obtained its authorization;
  - the quantity used under each trade name; and
  - the date and site of the event.

Reference: ER, 2013 S. 409

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Transportation of Special Effect Pyrotechnics

201

Explosives Act
R.S.C., 1985, c. E-17

Explosives Regulations

Transportation of Dangerous Goods Act
S.C., 1992, c. 34

Transportation of Dangerous Goods Regulations

202

Regulatory Agencies

Transports Canada
Transport Canada

Natural Resources Canada
Ressources naturelles Canada

OPP

Ontario
MINISTRY OF TRANSPORTATION

203

Natural Resources Canada
Ressources naturelles Canada

204

Explosives Regulations – Part 9

Transporting Explosives

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Explosives Regulations – Part 9

- The portion of the vehicle containing explosives is kept locked except during loading and unloading.
- A carrier must not transport explosives in a towed vehicle.
- Safety marks required when the vehicle is on public highways are also required when the vehicle is not on a public highway.
- Explosives must be packaged and contained in such a manner that, under normal conditions of transport, the likelihood of ignition is minimized.
- Ensure things other than explosives are not transported with explosives unless the things are stowed or separated from the explosives to minimize the likelihood of ignition.
- The vehicle to transport explosives must be in sound mechanical condition and inspected daily during transport.
- The driver must ensure that a parked vehicle is attended.
- A person must not smoke or be under the influence of a performance diminishing substance while in or attending a vehicle containing explosives.

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Fire Extinguishers

- The carrier must ensure that the vehicle that contains explosives is equipped with two fire extinguishers that have a rating of at least 4-A :40- B:C and are easily accessible.

Reference: SOR/2013-211 S. 191 (8)

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Explosives Regulations – Part 9

- A carrier or driver is not subject to the sections of the Explosives Regulations regarding the loading, unloading and in-transit requirements for explosives if they transport:
  - < 12 kg black powder
  - <150 kg UN0431, Articles Pyrotechnic (1.4G)
  - Any quantity of UN0432, Articles Pyrotechnic (1.4S) or UN0454, Igniters
- However, the explosives must be packaged and contained in such a manner that under normal conditions of transport, the likelihood of ignition is minimized.

Reference: SOR/2013-211; Part 9 S. 191 (1)-(2)

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Explosives Regulations – Part 9

http://laws.justice.gc.ca/PDF/SOR-2013-211.pdf

Or, search for "**Explosive Regulations Part 9**" using a search tool like Google.

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2020 211

Transports Canada Transport Canada

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2020 212

Packaging & Safety Marks

212

2020 213

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2020 214

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2020 215

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2020 216

Dangerous Goods

- Class 1 - Explosives
- Class 2 - Gases
- Class 3 – Flammable Liquids
- Class 4 – Flammable Solids, Substances liable to spontaneous combustion; Substances that on contact with water emit flammable gases
- Class 5 – Oxidizing Substances and Organic Peroxides
- Class 6 – Toxic Substances and Infectious Substances
- Class 7 – Radioactive Materials
- Class 8 – Corrosives
- Class 9 – Miscellaneous Products, Substances or Organisms

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Class

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Hazard Level

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CLASS 1 – Explosives – Hazard Levels

- 1.1 - A substance or article with a mass explosion hazard.
- 1.2 – A substance or article with a fragment projection hazard, but not a mass explosion hazard.
- 1.3 – A substance or article which has a fire hazard along with either a minor blast hazard or minor projection hazard, but not a mass explosion hazard.
- 1.4 - A substance or article which presents no significant hazard; explosion effects are largely confined to the package and no projection or fragments of appreciable size or range are to be expected.
- 1.5 - A very insensitive which nevertheless has a mass explosion hazard like those substances in 1.1.
- 1.6 - A very insensitive which does not have a mass explosion hazard.

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Compatibility Group

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Compatibility Groups for Explosives

A	A
B	B, S
C	C, D, E, N, S
D	C, D, E, N, S
E	C, D, E, N, S
F	F, S
G	G, S
H	H, S
J	J, S
K	K, S
L	L
N	C, D, E, N, S
S	B, C, D, E, F, G, H, J, K, N, S

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Common Classifications for Pyrotechnics

- **1.4G** Smoke pots, mines, gerbs, comets, etc.
- **1.4S** Bullet hits, electric matches, blank cartridges or articles with improved packaging.
- **1.3C** Smokeless Powder.
- **1.1D** Black Powder.
- **1.1B** Detonators, high strength squibs.

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T.D.G. - Special Provision 76

Despite TDG rules for compatibility groups, any combination of these explosives may be transported together in a road vehicle

IF

(a) the NEQ (Net Explosive Quantity) is less than or equal to **5 kg**;

AND

(b) the total number of igniters is less than or equal to **100**;

AND

(c) the operator of the road vehicle has a **valid Pyrotechnic Card** issued by the Explosives Regulatory Division of Natural Resources Canada.

Applicable UN Numbers:

UN0027, UN0066, UN0094, UN0101, UN0105, UN0161, UN0197, UN0255, UN0305, UN0325, UN0335, UN0336, UN0337, UN0349, UN0430, UN0431, UN0432, UN0454, UN0499

Reference: SOR/2016-95; S. 2-76

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TDG – Special Provision 76 Exemption List

- UN0027 – Black Powder 1.1D
- UN0066 – Cord, Igniter 1.4G
- UN0094 – Flash Powder 1.1G
- UN0101 – Fuse – Non-detonating 1.3G
- UN0105 – Fuse, Safety 1.4S
- UN0161 – Powder, Smokeless 1.3C
- UN0197 – Signals, Smoke 1.4G
- UN0255 – Detonators, Electric, for blasting 1.4B
- UN0305 – Flash Powder 1.3G
- UN0325 – Igniters 1.4G
- UN0335 – Fireworks (Display) 1.3G
- UN0336 – Fireworks (Consumer) 1.4G
- UN0430 – Articles Pyrotechnic 1.4G
- UN0431 – Articles Pyrotechnic 1.4G
- UN0432 – Articles Pyrotechnic 1.4S
- UN0454 – Igniters 1.4S
- UN0449 – Propellant, Solid 1.3C

http://wwwapps.tc.gc.ca/saf-sec-sur/3/sched-ann/schedule2.aspx?UN=&SP=76

Or, search for "**TDG Special Provision 76**" using a search tool like Google.

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Section 1.15, 150 kg Gross Mass Exemption

The TDG requirements for Training, Documentation, Vehicle Placards, UN Packaging, and Spill Reporting do not apply to the transporting of explosives with a ***Gross Mass*** < 150kg

IF

Each individual package is <30kg Gross Mass;

AND

Are being transported by the user or purchaser;

AND

Belong to one of the following groups:

- UN0161 Powder, Smokeless
- UN0335 Fireworks (if classified as a consumer firework)
- UN0336 Fireworks
- UN0337 Fireworks
- UN0431 Article Pyrotechnics, for technical purposes
- UN0432 Article Pyrotechnics, for technical purposes

Reference: SOR/2016-95; Part 1.15

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Class 1 Explosives Exemption, Section 1.31

The TDG requirements for Training, Documentation and Vehicle Placards do not apply to transporting explosives:

IF

(A) The ***NEQ*** is less than or equal to 25kg

AND

(B) For **Igniters**, there are less than or equal to **100 *pieces***

AND

(C) Each box meets UN shipping requirements and has the appropriate diamond label and UN number.

BUT

(D) The vehicle must be Placarded appropriately
(Training and TDG Paperwork are still not needed.)

IF

(i) The explosives are part of class **1.1**, **1.2**, **1.3**, or **1.5** and over **10kg**

OR

(B) For **Igniters**, there are greater than **1,000 *pieces***

Reference: SOR/2016-95; Part 1.31

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Transport of Dangerous Goods – Special Effect Pyrotechnics

- Check the UN number of the products you are transporting and ensure you are complying with the TDG regulations.
- Take a training course to be "adequately trained" in the transport of dangerous goods.
- Training is employer specific and non-transferable.

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- A complete playlist of all videos in this presentation can be found at:

https://www.youtube.com/watch?v=YMH1GT3Pug8&list=PLA6fF7fPepvNYklUqMAa20g0ZMl0epOh6

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Resources

- National Fireworks Certification Program
- Special Effects Pyrotechnics Manual
- Publications
- Pyrotechnics Associations
- Other Sources

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The National Fireworks Certification Program

Email: ERDmms@nrcan.gc.ca

Phone: 343-292-8741 **Fax**: 613-948-5195

Website:
http://www.nrcan.gc.ca/explosives/fireworks/9885

ERD Contact: Rachel Robbins
rachel.robbins@nrcan-rncan.gc.ca

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Publications

- Encyclopedic Dictionary of Pyrotechnics, Journal of Pyrotechnics, Inc. Authors: Ken and Bonnie Kosanke
- NFPA 1126 - Standard for the Use of Pyrotechnics Before a Proximate Audience (National Fire Protection Association)
- NFPA 160 - Standard for the Use of Flame Effects Before an Audience

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Associations

- Canadian National Fireworks Association – CFNA
- PGI – Pyrotechnics Guild International

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Other Sources

- GunSmoke Canada – Mark Fine
  www.gunsmoke.ca gunsmokecanada2020@gmail.com
- AirMagic Special Effects
  www.airmagicfx.com info@airmagicfx.com

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Final Steps

- Test
- Evaluation
- You will need to apply to ERD to obtain your Fireworks Operator Certificate.

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Test

- Download your copy of the test from the following url:

www.gun-smoke.ca/pyrotechnicstest

- At the top of the form, be sure to enter your Full Name
- The test is a PDF form. You will require a PDF reader such as Adobe Acrobat or similar program. Mark off your answer for each question.
- When you have completed the test - SAVE IT
- Send completed test to: **gunsmokecanada2020@gmail.com**
- You have 30 min. to complete the test.
- Stay logged into Zoom after completing the test, the course will continue.
- We will e-mail you your results and certificate within 10 business days

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Applying for Pyrotechnician

We have put up an easy to follow "How To" guide for applying for or renewing your certification with ERD on the Gunsmoke Canada Website.

https://www.gun-smoke.ca/copy-of-about

This link will direct you on what you need and how to register for the NRCan eServices portal.

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GunSmoke Canada

www.gunsmoke.ca

ERD-Authorised Pyrotechnics Safety and Legal Awareness Course

Mark Fine

gunsmokecanada2020@gmail.com

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