

Avalanche Control Training

State of Colorado

Department of Labor and Employment

Division of Oil and Public Safety

Fuse versus Fuze

Etymology [edit]

Professional publications about explosives and munitions distinguish the "fuse" and "fuze" spelling.^{[5][6]} The UK Ministry of Defence states (emphasis in original):

FUSE: Cord or tube for the transmission of flame or explosion usually consisting of cord or rope with gunpowder or high explosive spun into it. (The spelling FUZE may also be met for this term, but FUSE is the preferred spelling in this context.)^[7]

FUZE: A device with explosive components designed to initiate a main charge. (The spelling FUSE may also be met for this term, but FUZE is the preferred spelling in this context.)^[8]

Oliver Hogg states the following about fuze:

The word "fuze" is often spelt "fuse" by those unacquainted with artillery usage. This is incorrect. "Fuse", derived from *fusus*, the past participle of *fundo*, means "to melt", e.g., the term "fuse-wire" used in electrical circuits. "Fuze", on the other hand, is the shortened or modern method of spelling "fuzee", meaning a tube filled with combustible material. It is a derivation of *fusus*, a spindle and from the French *fusee*, a spindle full of thread. It is well to make this point at the outset.^[9]

Historically, it was spelled with either 's' or 'z', and both spellings can still be found.^[10] In the United States and some military forces,^[11] *fuze*^[12] is used^{[13][14][15][16]} to denote a sophisticated ignition device incorporating mechanical and/or **electronic** components (for example a **proximity fuze** for an **artillery shell**, **magnetic/acoustic fuze** on a **sea mine**, spring-loaded **grenade fuze**,^{[17][18][19]} **pencil detonator** or **anti-handling device**)^[20] as opposed to a simple burning **fuse**.^[21]

Colorado State Laws and Regulations

Purpose of Laws

Control procurement of and access to explosives.

Issue permits to qualified applicants.

Safety of the workers, the public, and the protection of property.


Regulations revised March 2015

Basic Characteristics of Explosives

1) Chemical compound or mixture capable of producing an explosion.

Basic Characteristics

2) Ignition of explosive material
may be caused by
friction, impact, shock,
heat or electricity.



Basic Characteristics



- 3) Energy is released through:
- Heat transfer
- Shock waves
- Rapid expansion of gasses

Basic Characteristics



- 4) Rate of explosion
- High explosives *detonate*
- (explode faster than the speed of sound)
- Low explosives *deflagrate* (burn)

Basic Characteristics



- 5) Four effects caused by explosives
 - a) fragmentation
 - b) displacement
 - c) ground vibration
 - d) air blast

Definitions

- High explosives:
 - 1) very high rate of reaction
 - 2) high pressure development
 - 3) presence of a detonation wave
- Detonate (explode faster than the speed of sound)
- Examples: cast boosters, detonation cord, detonators (blasting caps)
- TNT, PETN, RDX

Definitions



- **Low explosives:** compounds which decompose slower than the speed of sound.
- Low rate of reaction
- Deflagration (burn)
- Development of low pressures
- Examples: black powder, safety fuse and
- pull wire igniters

Definitions

- **Blasting agent:**
- Material intended for blasting
- Consists of fuel and an oxidizer
- Material not otherwise defined as an explosive
- Cannot be detonated by means of a No. 8 blasting cap when unconfined
- Example: anfo

Definitions



Blaster-in-charge:

The person who is in charge of the blast.

Responsibilities include:

Planning the blast

Supervising all persons assisting on the blast (including trainees)

Preparing the explosive charges

Initiating the blast

Inventory, inventory records, and blast records

Blaster-in-charge must be physically present at the specific job site.

Definitions



Explosive charge:
measured amount of explosive material

Explosive Compounds

TNT(trinitrotoluene):

relatively stable

cap sensitive

water resistance: good

Cast TNT

Density: 1.56 g/cc

Detonation velocity : approx. 22,000 feet/second (confined)

Uses : primer and booster for blasting agents

sensitizer for slurries

**ingredient in explosive mixtures Pentolite and
composition B**

Explosive Compounds

PETN (pentaerythritol tetranitrate):

secondary explosive (not as sensitive as a primary explosive such as nitroglycerin or lead azide)

Detonation velocity: around 26,000 ft/sec (confined)

Common form: various degrees of granulation

Uses: priming composition in detonators

base charge in blasting caps

core load for detonating cord

ingredient in Pentolite mixture

Explosive Compounds



RDX (cyclotrimethylene-trinitramine):

second to nitroglycerin in strength among common explosive substances.

Detonation velocity: approx. 27,000 feet/second (confined)
when compressed to a density of 1.70 g/cc

Uses: primary ingredient in composition B
base charge for detonators.

Explosive Mixtures



Composition B:

a mixture of RDX and TNT with 1 to 4 percent wax added.

Common form: cast

Density of 1.65 g/cc

Detonation velocity: approx. 22,000 feet/second

Uses: primer and booster for blasting agents

Explosive Mixtures



Pentolite: a mixture of PETN and TNT. The percentage of PETN can be from 20 percent to 60 percent, with the remainder being TNT.

Common form: cast

Density 1.60 g/cc

Detonation velocity : approx. 26,000 feet/
second

Uses: primer and booster for blasting agents

ANFO: *ammonium nitrate/ fuel oil*
blasting agent



Detonators



Any device that is used for initiating detonation.

Contains initiating or primary explosives.

May not contain more than 10 grams of explosives excluding ignition or delay charges.

Examples of detonators



- Blasting caps for use with safety fuses
- Electric blasting caps
- Exploding bridgewire detonators
- Detonating cord delay connectors
- Nonelectric blasting caps

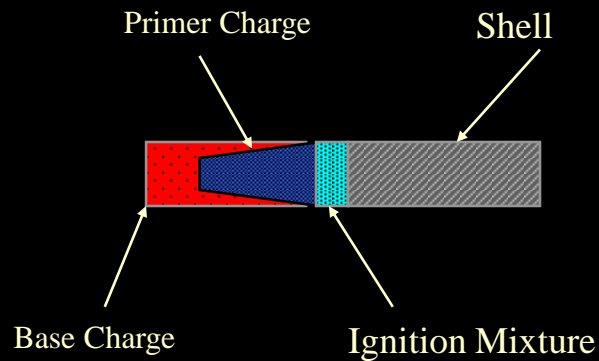
Blasting Cap:

Metallic capsule

Contains initiating explosive and a base charge,

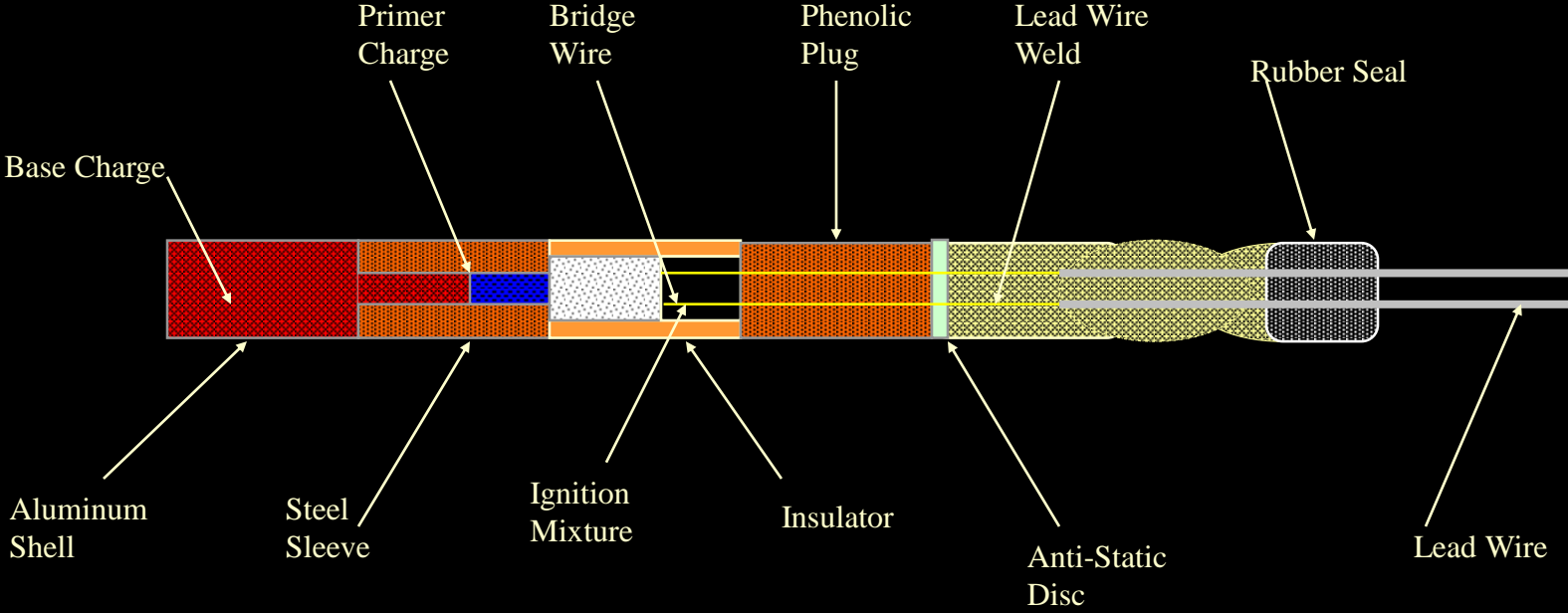
Open at the upper end to accept a section of safety fuse


Initiates the primer or main charge.



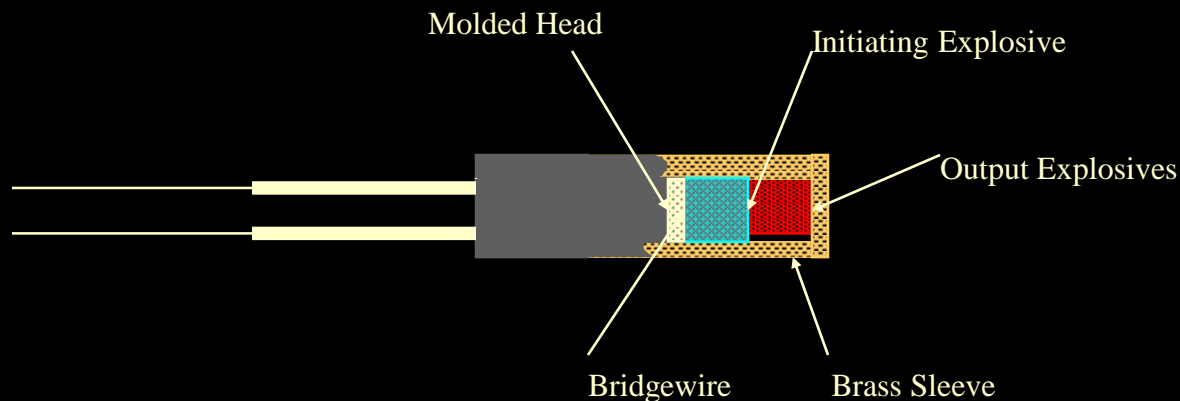
Electric blasting cap:

Initiates a detonation by means of an electric current.

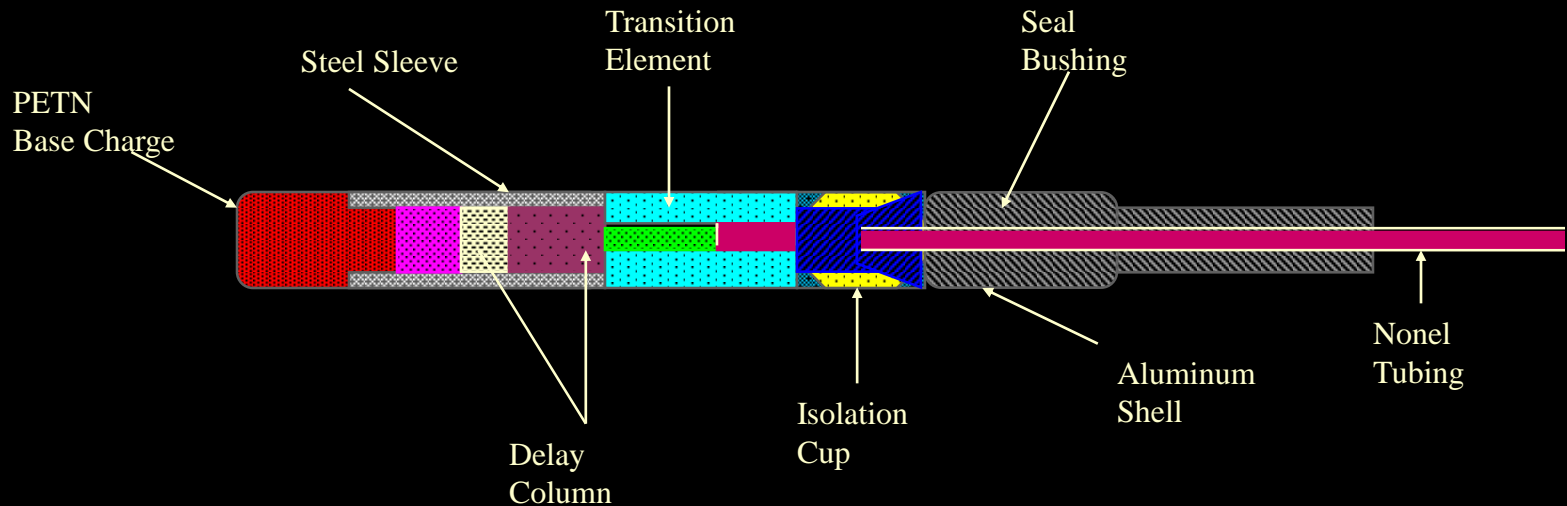




EBW (Exploding Bridgewire): a high amount of electrical current is delivered to the bridge wire, which explodes, and initiates the secondary explosive.



Nonelectric delay device: A detonator with an integral delay element, used in conjunction with and capable of being initiated by, a detonating impulse.



Detonating Cord

Core : contains high explosive, usually PETN,

Sheath: made of waterproof plastic

Covering: reinforced with textile, plastic, wire, and waterproofing materials.

Range of explosive core: 1 grain/ft to 400 grains/ft.

**25 or 50 grains/ft detonates a cap sensitive explosive
(but will not reliably detonate a blasting agent)**

**All grades can be detonated with a blasting cap and have a
detonation velocity of about 22,000 feet per second.**



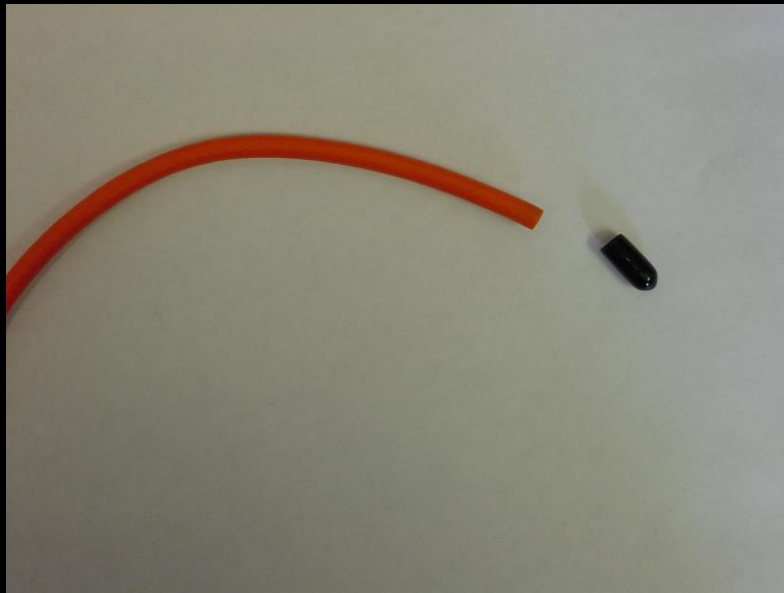
Safety Fuse



Safety fuse is a medium through which flame is continuously conveyed at a relatively uniform speed to initiate the heat-sensitive charge in an ordinary blasting cap. The core of safety fuse is a black powder train, tightly wrapped by coverings of tape, textiles, and waterproofing materials such as asphalt and plastics.



Preventing extraneous electricity



Boosters versus Primers



Booster: a high explosive used to detonate a less sensitive explosive-one that won't detonate with only a blasting cap.

e.g. a pentolite cast without a blasting cap

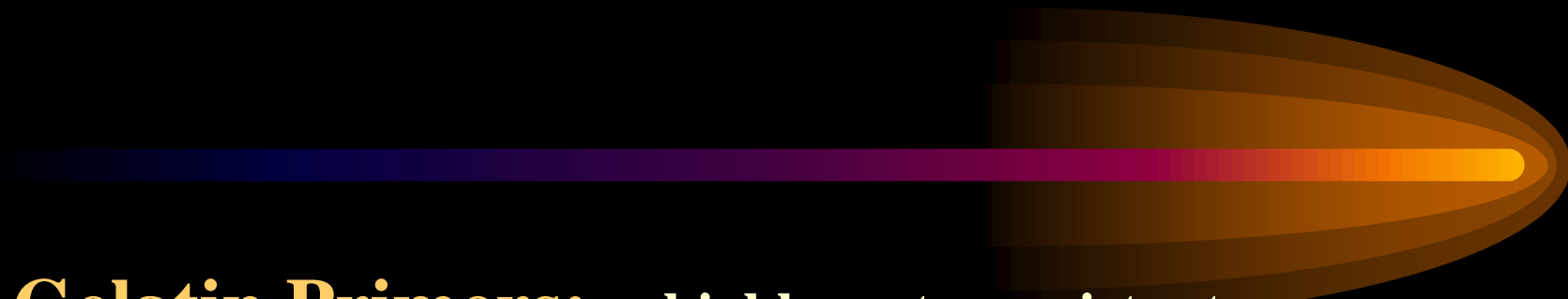
Primer: a booster that contains a detonator or contains detonating cord to which a detonator is attached.

e.g. a pentolite cast armed with a blasting cap.

Primers

Cast Primers: a high-density, pressed, or cast cylinder of TNT, Pentolite, and/or other ingredients. Cast primers have a high detonating velocity of 26,000 feet/second, are not affected by wet conditions, cannot freeze, will not leak explosive oils, and have an unlimited shelf life when stored properly. Cast primers do not contain nitroglycerin.





Gelatin Primers: a highly water-resistant nitroglycerin type explosive. Gelatin primers have detonation velocity of up to 20,000 feet/second, a high percentage of nitroglycerin mixtures that freeze at -20° F, may deteriorate, may produce headaches, and are more shock-sensitive than other primers. Gelatin primers are generally less costly than cast primers and do not create a black residue crater.



DYNOMAX™ PRO

Extra Gelatin Nitroglycerin Dynamite



Product Description

DYNOMAX PRO is desensitized extra gelatin dynamite designed to satisfy the majority of explosive application requirements. DYNOMAX PRO is formulated to consistently deliver high detonation velocity and excellent water resistance while reducing cartridge to cartridge gap sensitivity and hole-to-hole propagation problems. DYNOMAX PRO is recommended for bottom loading and as the main explosive charge where high density and energy is required. DYNOMAX PRO is recommended for use as booster, bottom load or floor control solution.

Application Recommendations

- DYNOMAX PRO is an excellent primer for Dynamix (ANFO), Dynamix WR (WR ANFO) or other detonator sensitive packaged product and can be used as a secondary primer in hard seams or at the top of the explosive column.
- Minimum diameter is 32 mm (1¼ in).
- Minimum detonator is No. 8 strength.
- DYNOMAX PRO has been formulated to reduce susceptibility to sympathetic detonation when applied in very wet conditions where boreholes are closely spaced and/or where geological conditions promote this effect. Consult your Dyno Nobel representative for product recommendations where these conditions exist.
- Storage at elevated temperatures and/or high humidity for 12-18 months can reduce the performance of DYNOMAX PRO depending on the diameter. Consult your Dyno Nobel representative for specific recommendations.

Technical Information



Properties

SDS
#1019

Density (g/cc) Avg	1.45
Energy^a (cal/g)	1,055
(cal/cc)	1,510
Relative Weight Strength^a	1.20
Relative Bulk Strength^{a,b}	2.10
Velocity^c (m/s)	5,275
(ft/s)	17,300
Detonation Pressure^c (Kbars)	101
Gas Volume^a (moles/kg)	32
Water Resistance	Excellent
Fume Class^d	IME1

^a All Dyno Nobel Inc. energy and gas volume values are calculated using PRODET™ the computer code developed by Dyno Nobel Inc. for its exclusive use. Other computer codes may give different values.

^b ANFO = 1.00 @ 0.82 g/cc

^c Unconfined @ 50 mm (2 in) diameter.

^d IME Fume Class 1 in convolute paper shell only. Not Fume Class 1 in paper tube shell. Natural Resources Canada Fume Class approvals pending.

Hazardous Shipping Description

Explosive, Blasting, Type A 1.1D UN 0081 II



1.1D

Emulsions

Detonator Sensitive Emulsions:

contain a refined mixture of oxidizers and fuels with glass micro-balloons or air voids added for sensitivity in an emulsifying agent.

velocity of detonation: up to 19,000 feet/second.

excellent stability, shelf life, and water resistance

sensitive to a No. 8 cap at 10 ° F.

generally less costly than cast primers and

do not create a black residue crater.



Storage of Explosive Materials

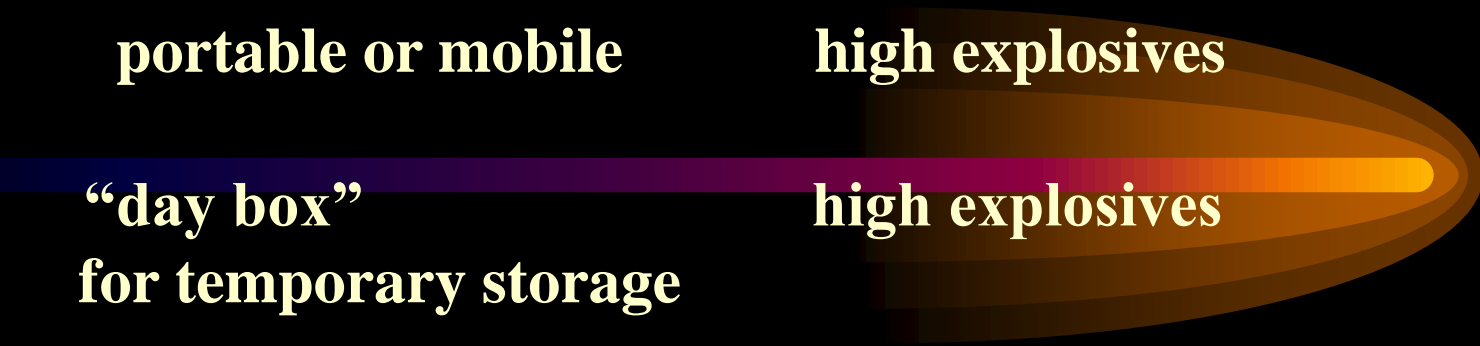


All explosive materials shall be kept in magazines which meet the requirements as defined in the Code of Colorado Regulations.

High explosives shall not be stored unattended outdoors, or in any building or structure, except in a Type 1 or Type 2 magazine.

Magazine Types

Type 1	permanent	high explosives
Type 2	portable or mobile	high explosives
Type 3	“day box” for temporary storage	high explosives
Type 4	portable or mobile	low explosives or blasting agents
Type 5	portable or mobile	blasting agents



Type 1 Magazine

a permanent structure for the storage of high explosives.

Type 1 magazine must be:

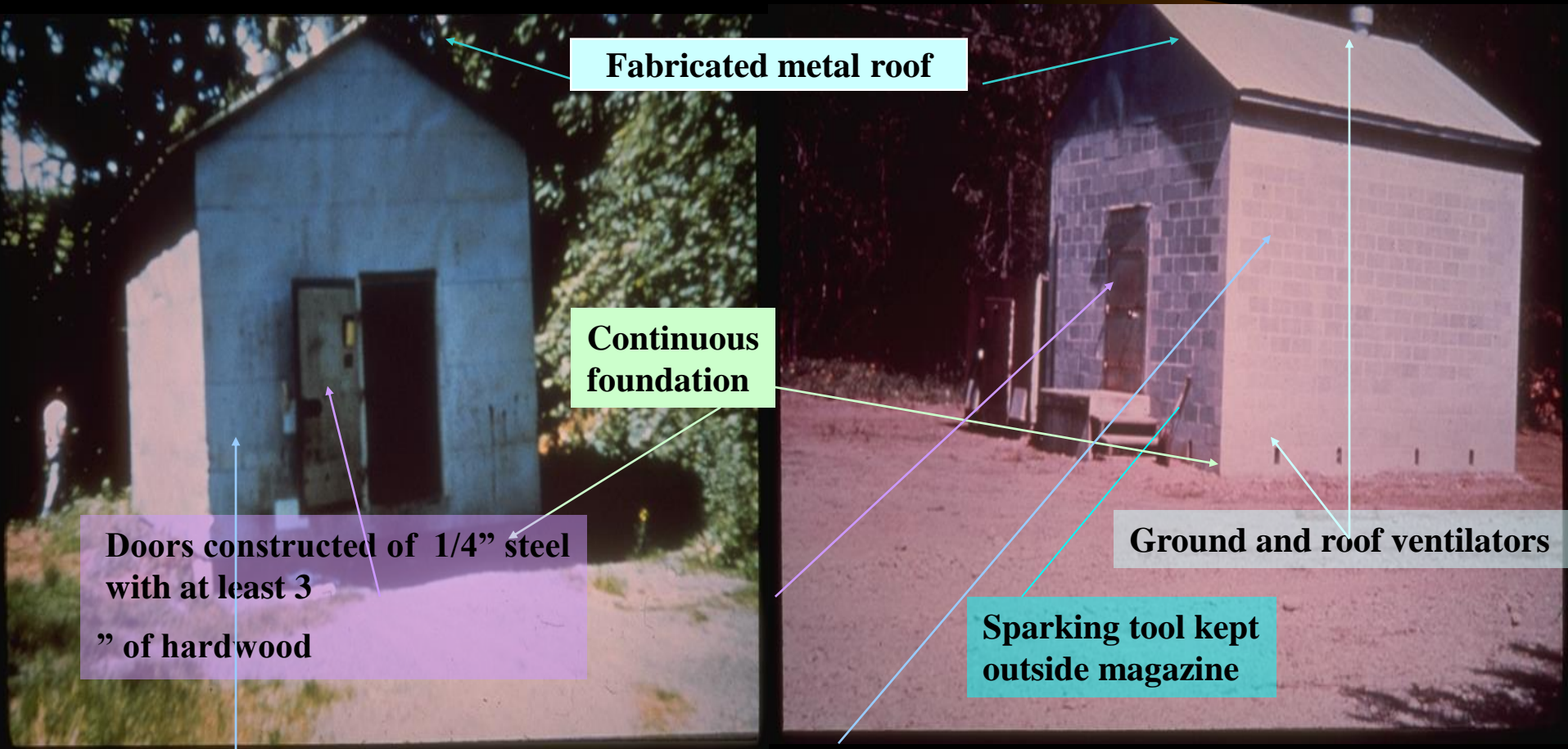
bullet-resistant

weather-resistant

theft-resistant

well ventilated

TYPE 1 MAGAZINES



Fabricated metal roof

Continuous foundation

Doors constructed of 1/4" steel with at least 3" of hardwood

Ground and roof ventilators

Sparking tool kept outside magazine

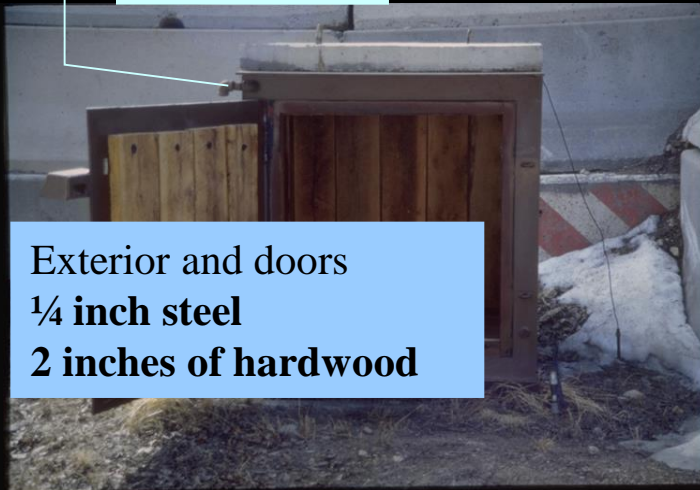
Masonry wall construction of concrete, brick, tile, cement block, or cinder block not less than 6 inches thick. with hollow spaces filled with sand or weak concrete. Interior walls constructed of or covered with a non-sparking material.

Type 2 magazines

- Mobile or portable facility used for the storage of high explosives.
- At least one cubic yard in size (or securely fastened to a fixed object),
- bullet-resistant
- fire-resistant
- weather-resistant
- theft-resistant
- well ventilated.

TYPE 2 MAGAZINE

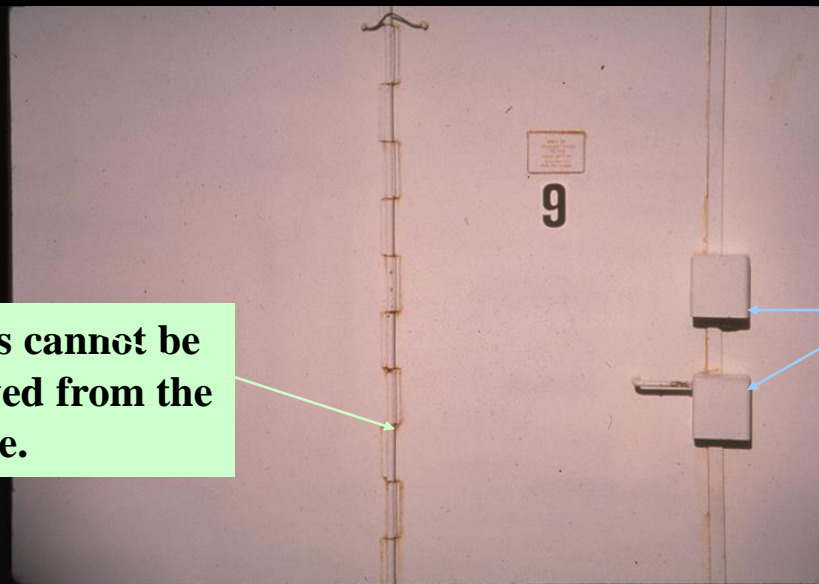
Ventilator



**Exterior and doors
1/4 inch steel
2 inches of hardwood**



**Ground sloping away from
magazine for drainage.**



**Hinges cannot be
removed from the
outside.**

**2 padlocks with at least five
tumblers and a case-hardened
shackle of at least 3/8 inch diameter.**

1/4 inch steel hoods

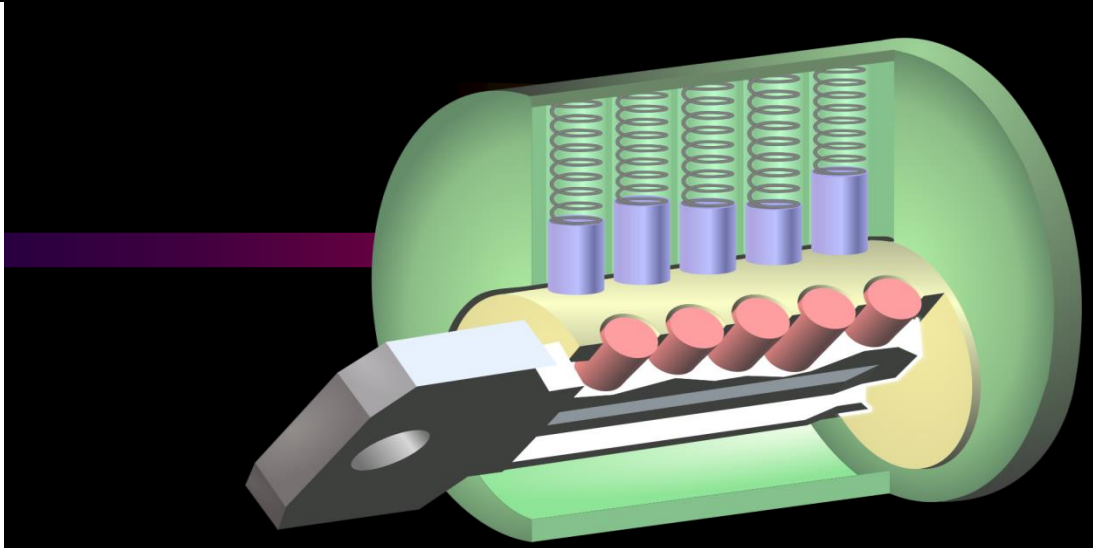
Locks for Type 2 magazine



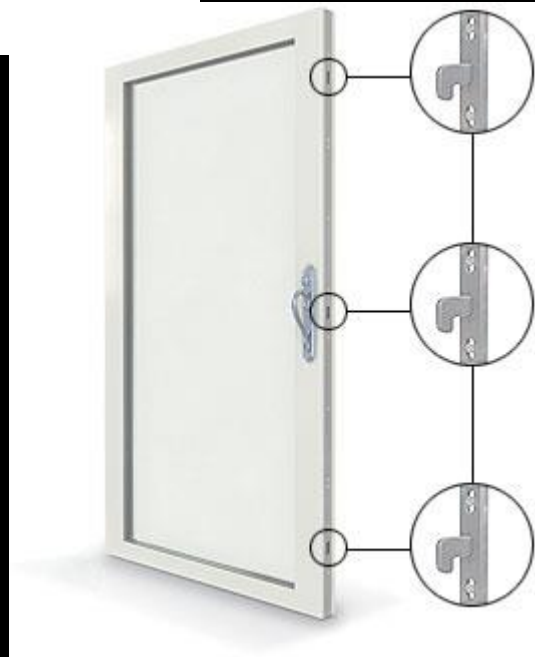
- 2 mortise locks
or
- 2 padlocks fastened in separate hasps and staples
or
- A mortise lock and a padlock
or
- A three point lock



Mortise lock

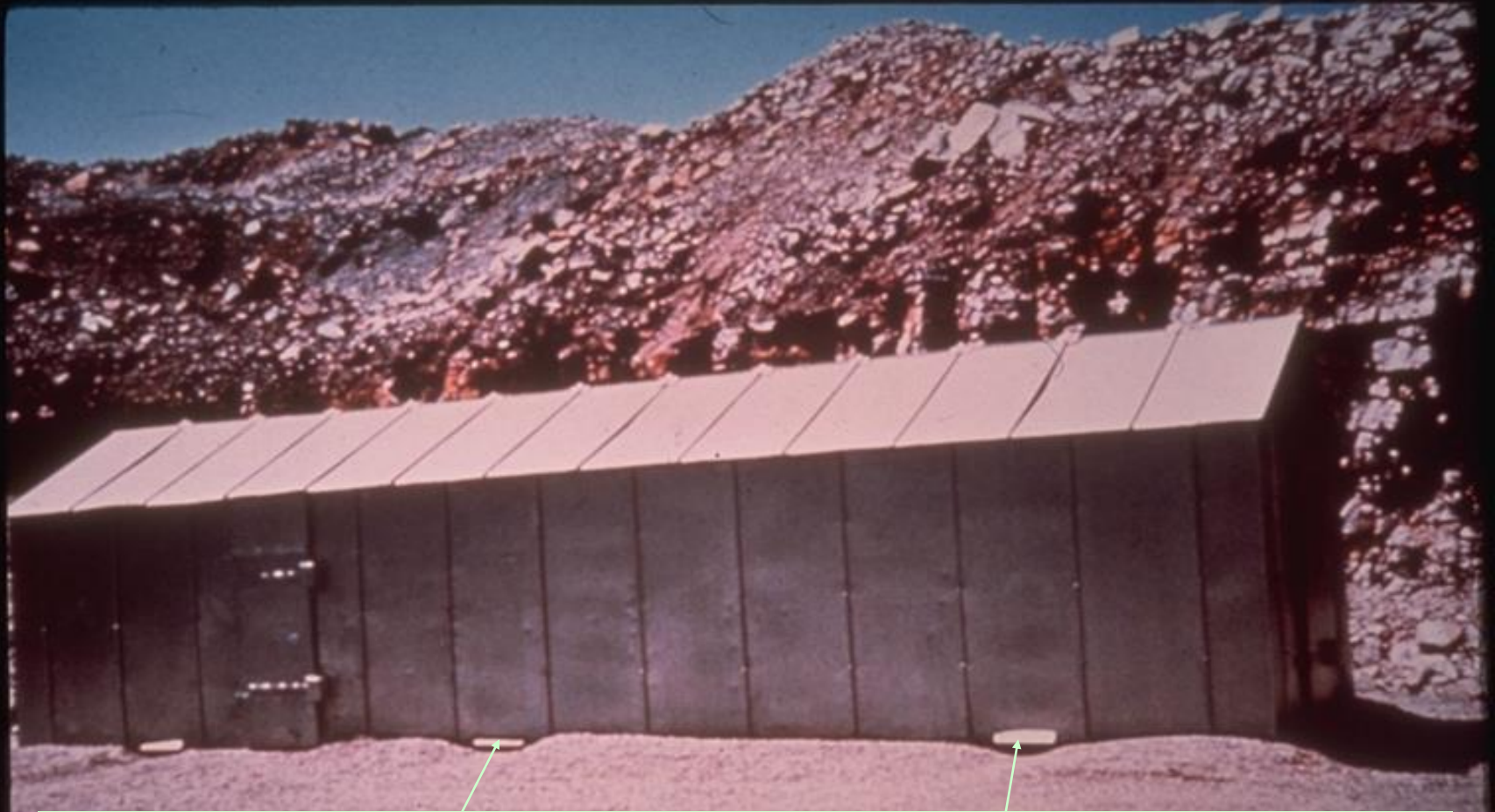


**5 tumbler padlock
case-hardened shackle
3/8 inch diameter**



Three point lock

TYPE 2 OUTDOOR STORAGE



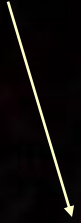
Ventilation openings must be screened to prevent the entrance of sparks. Ventilation openings in side walls and foundations must be offset or shielded for bullet resistance purposes.

Aspen Highlands Ski Area Main Storage

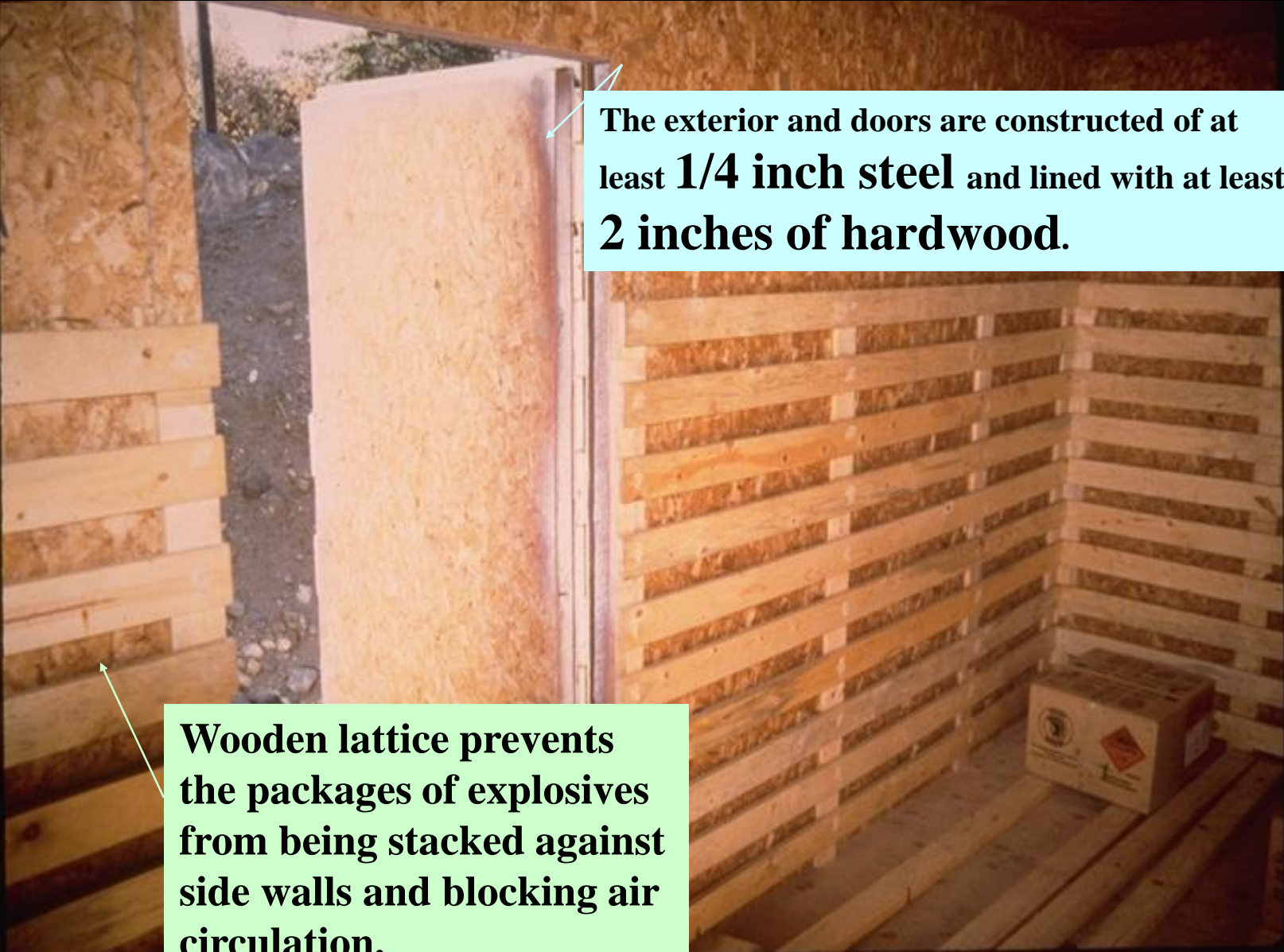
Pyramid Park Ski Run

Main Explosive Cache

Detonator Cache



Type 2 outdoor magazines

The image shows the interior of a storage container. The walls are constructed from horizontal wooden planks, creating a lattice structure. A door is open on the left side, revealing the exterior which is also made of wooden planks. The floor is also made of wooden planks. A cardboard box is visible in the corner of the container.

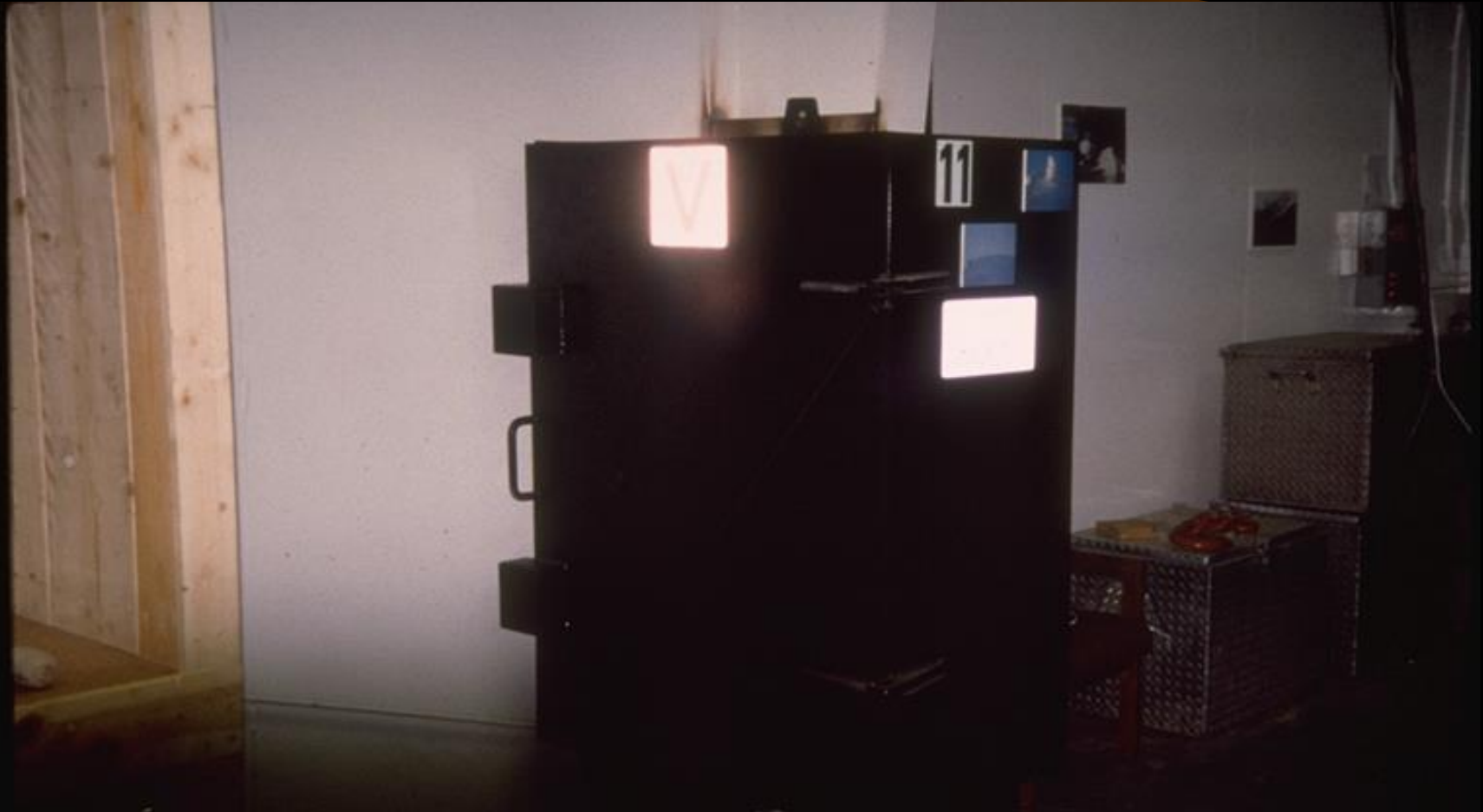
The exterior and doors are constructed of at least **1/4 inch steel** and lined with at least **2 inches of hardwood**.

Wooden lattice prevents the packages of explosives from being stacked against side walls and blocking air circulation.

**Note:
Nail heads covered
by non-sparking
material**



Indoor Type 2 Magazine



Indoor magazines must be fire-resistant and theft-resistant, it cannot be located in a dwelling or inhabited building. The indoor storage of high explosives must not exceed 50 lbs. and the total quantity of detonators must not exceed 5,000.

Indoor Type 2



2 inches of hardwood covered by not less than 26-gauge steel or constructed of 12-gauge steel and lined with a non-sparking material. Hinges and hasps must be attached to doors by welding, riveting, or bolting. Padlocks must have at least 5 tumblers and 3/8 inch case hardened steel shackle and be protected with not less than 1/4 inch steel hoods.

Type 3 Magazines

portable magazines (**day-boxes**) used for the temporary storage of high explosives while attended.

Other classes of explosives may also be stored temporarily in Type 3 magazines.

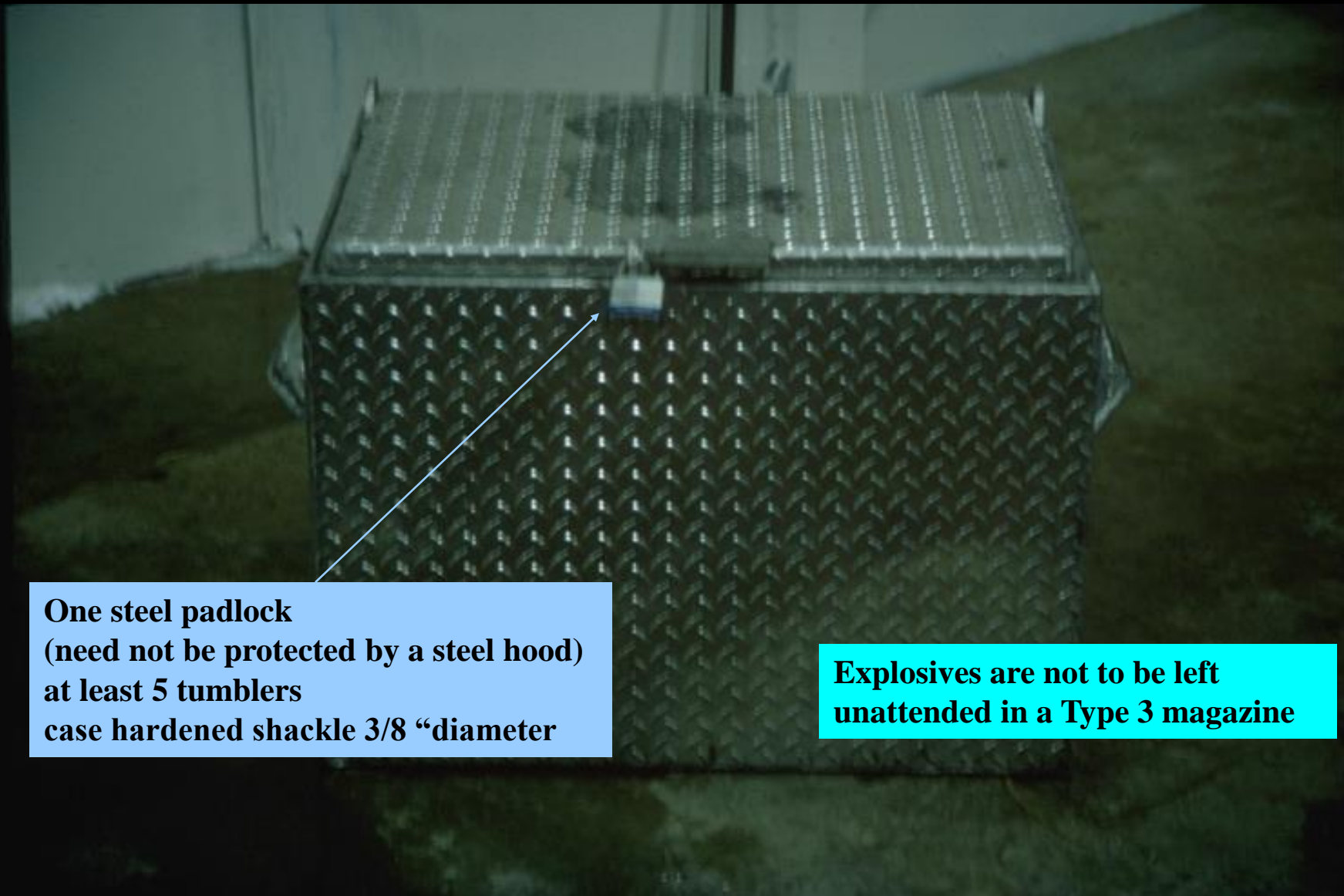
Fire-resistant, weather-resistant, and theft-resistant, but may be less than one cubic yard in size.

Type 3 Day Box

Doors must overlap door openings by at least one inch. Hinges and hasps must be attached by welding, riveting, or bolting (nuts on the inside).



A Type 3 magazine must be fire-resistant, weather-resistant, and theft-resistant. Construction must be of not less than 12-gauge steel, or aluminum, and lined with at least 1/2 inch plywood or 1/2 inch masonite type hardboard.



**One steel padlock
(need not be protected by a steel hood)
at least 5 tumblers
case hardened shackle 3/8 "diameter**

**Explosives are not to be left
unattended in a Type 3 magazine**

Type 4 Magazines

Type 4 storage magazines may be a building, a box, a trailer, or a semi-trailer or other mobile facility used for the **storage of low explosives.**

Blasting agents may be stored in a Type 4 magazine.

need not be bullet-resistant,
but must be fire-resistant,
weather-resistant
theft-resistant.

Type 4 Outdoor Magazine

Type 4 magazines must be fire-resistant, weather-resistant, and theft-resistant. The interior must be lined with non-sparking material. Padlocks must have at least 5 tumblers and a case hardened steel shackle of at least 3/8 inch diameter and must be protected with 1/4 inch steel hoods.



When unattended, vehicular magazines must have wheels removed or otherwise be effectively immobilized by kingpin locking devices or other methods approved by the director.



*Storage
Surrounding Area*

The land surrounding a magazine shall be kept clear of all combustible materials, trash, dried grass, leaves and other materials for a distance of at least 25 feet.

Combustible materials shall not be stored within 50 feet of magazines.



Smoking, matches or an open flame shall not be permitted:

In any magazine;

Within 50 feet of any outdoor magazine; or

Within any room containing an indoor magazine.

Firearms shall not be permitted inside of, or within 50 feet of magazines.

Warning Signs



The premises on which all outdoor magazines are located shall be posted with signs containing the words

“DANGER--KEEP OUT” in letters at least 3 inches high.

Signs shall be posted to warn any person approaching the magazine of the presence of explosives, but shall be located so that a bullet passing through the face of the sign will not strike the magazine.

Properly Placed Explosive Warning Signs

Note: Signs are not in direct alignment with Magazine.





Magazines located adjacent to a public area where signs may act as advertising shall not have signs containing the word “explosive” but shall be marked in such a manner as to notify emergency workers as to the danger of the contents of the magazines in case of fire.

Hazardous Materials

DOT 9 Classes of Hazardous Materials



DOT classifications include the following:

- Class 1 Explosives
- Class 2 Gases
- Class 3 Flammable liquids
- Class 4 Flammable solid
- Class 5 Oxidizer
- Class 6 Poison
- Class 7 Radioactive
- Class 8 Corrosive
- Class 9 Miscellaneous



DOT Hazard Class 1: Explosives

- Division 1.1: mass explosion hazard
- Division 1.2: projection hazard
- Division 1.3: predominantly a fire hazard
- Division 1.4: minor explosion hazard
- Division 1.5: Very insensitive explosives
- Division 1.6: Extremely insensitive explosive articles



Division 1.4 Explosives

1.4 explosives present a **minor explosion hazard**. The explosive effects are largely confined to the package and no projection of fragments of appreciable size or range is to be expected.

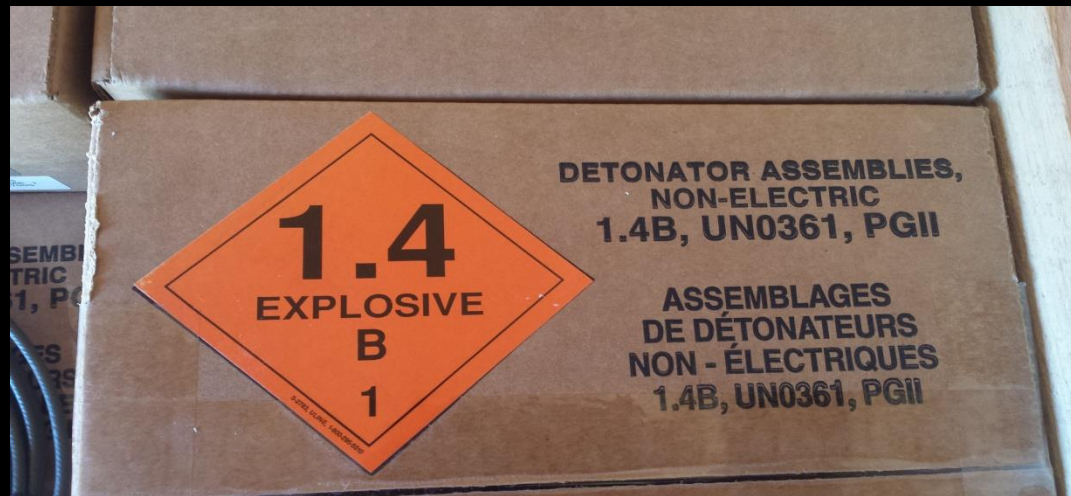


Table of Distances

Table 4-5-1		American Table of Distances for Storage of Explosive Materials							
Quantity of Explosive Materials^(1,2,3,4)		Distances in Feet							
		Inhabited Buildings⁽⁵⁾		Public Highways with Traffic Volume of less than 3,000 Vehicles/Day⁽¹¹⁾		Passenger Railways-Public Highways with Traffic Volume of more than 3,000 Vehicles/Day^(10, 11)		Separation of Magazines⁽¹²⁾	
Pounds Over	Pounds Not Over	Barricaded^(6,7,8)	Unbarricaded	Barricaded^(6,7,8)	Unbarricaded	Barricaded^(6,7,8)	Unbarricaded	Barricaded^(6,7,8)	Unbarricaded
0	5	70	140	30	60	51	102	6	12
5	10	90	180	35	70	64	128	8	16
10	20	110	220	45	90	81	162	10	20
20	30	125	250	50	100	93	186	11	22
30	40	140	280	55	110	103	206	12	24
40	50	150	300	60	120	110	220	14	28
50	75	170	340	70	140	127	254	15	30
75	100	190	380	75	150	139	278	16	32
100	125	200	400	80	160	150	300	18	36
125	150	215	430	85	170	159	318	19	38
150	200	235	470	95	190	175	350	21	42
200	250	255	510	105	210	189	378	23	46
250	300	270	540	110	220	201	402	24	48
300	400	295	590	120	240	221	442	27	54
400	500	320	640	130	260	238	476	29	58
500	600	340	680	135	270	253	506	31	62
600	700	355	710	145	290	266	532	32	64
700	800	375	750	150	300	278	556	33	66
800	900	390	780	155	310	289	578	35	70
900	1,000	400	800	160	320	300	600	36	72
1,000	1,200	425	850	165	330	318	636	39	78
1,200	1,400	450	900	170	340	336	672	41	82
1,400	1,600	470	940	175	350	351	702	43	86

Storage Capacity



Pyramid cache

1,048 feet to the Cloud Nine lift line.

1,800 feet to the Merry-Go-Round restaurant

Unbarricaded to Inhabited Building:

14,000 to 16,000 pounds

maximum storage allowed

Storage Capacity



Far Woods cache

414 feet from the top of **Deep Temerity** lift

Unbarricaded Passenger Railway:

250 to 300 pounds
maximum storage allowed

Storage of Explosive Materials

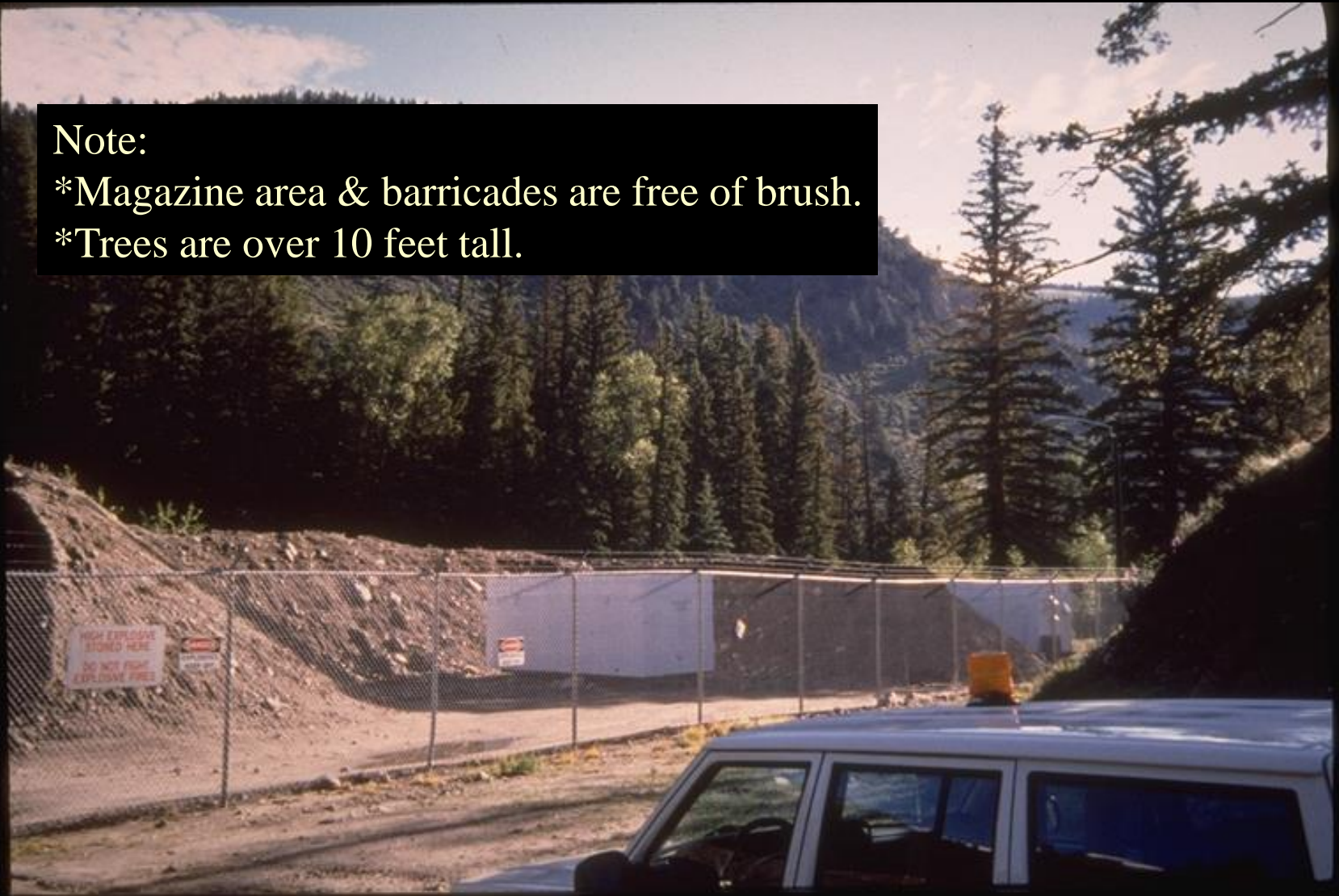
Temporary storage at a site for blasting operations shall be located away from neighboring inhabited buildings, railways, highways, and other magazines in accordance with the Table of Distance. A distance of at least 150 feet shall be maintained between magazines and the work in progress when the quantity of explosives stored is in excess of 25 lbs., and a distance of 50 feet when the quantity stored is less than 25 lbs.

Multiple Magazines at One Site

Note:

*Magazine area & barricades are free of brush.

*Trees are over 10 feet tall.



Type 2 Outdoor With Barricade

Note: Barricade is higher than roof & free of vegetation.



Storage within Magazines



Explosives and detonators (blasting caps) shall not be stored unattended outdoors, or in any building or structure, except in a Type 1 or Type 2 magazine that has been approved.



Blasting caps, electric blasting caps, non-electric caps, detonating primers or flame producing devices shall not be stored in the same magazine in which other explosives are kept or stored except under the following circumstances:

In a Type I or Type II magazine, detonators may be stored with delay devices, electric squibs, safety fuse, igniters, and igniter cord.



Any two components which when mixed, become capable of detonation by a number 6 cap (binary explosives) must be stored in separate locked containers. The liquid portion of binary explosives is flammable and cannot be stored with explosives.

Inside of Pyramid High Explosives Cache



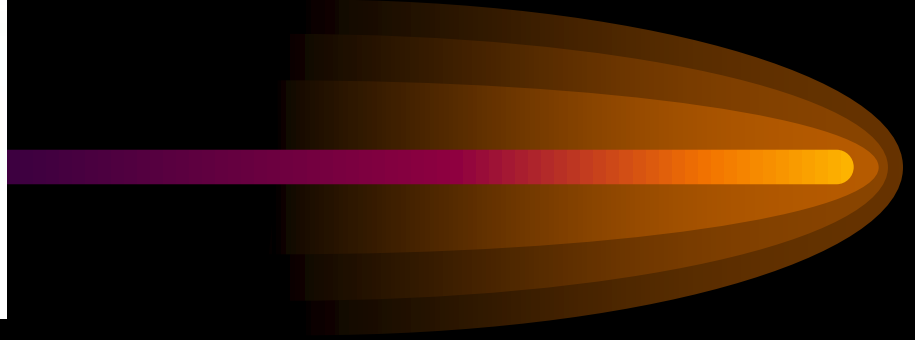
**Packages of explosives laid flat with top side up.
Corresponding grades and brands shall be stored together
All stocks stored so as to be easily counted and checked.
Packages of explosives shall be stacked in a stable manner.**

Storage within Magazines



Always use the oldest explosives of any particular kind first.

Packages of explosives requiring impact or potentially spark producing methods to open or close shall not be opened or closed in a magazine, nor within 50 feet of a magazine or in close proximity to other explosives.

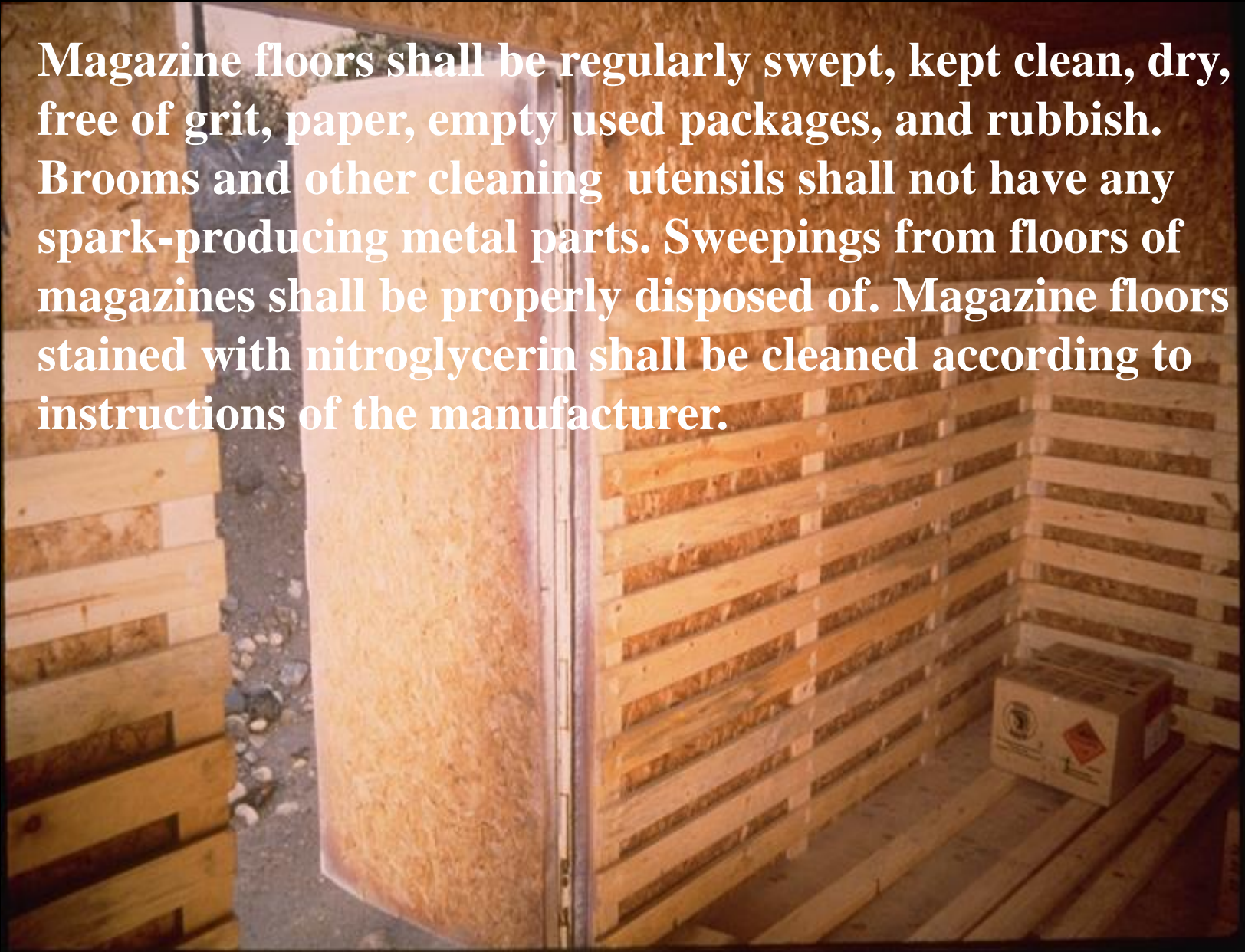


Tools used for opening packages of explosives shall be constructed of non-sparking materials.

Opened packages of explosives shall be securely closed before being returned to a magazine.

Magazines shall not be used for the storage of any metal tools nor any commodity except explosives, but this restriction shall not apply to the storage of blasting agents and blasting supplies.

Magazine floors shall be regularly swept, kept clean, dry, free of grit, paper, empty used packages, and rubbish. Brooms and other cleaning utensils shall not have any spark-producing metal parts. Sweepings from floors of magazines shall be properly disposed of. Magazine floors stained with nitroglycerin shall be cleaned according to instructions of the manufacturer.

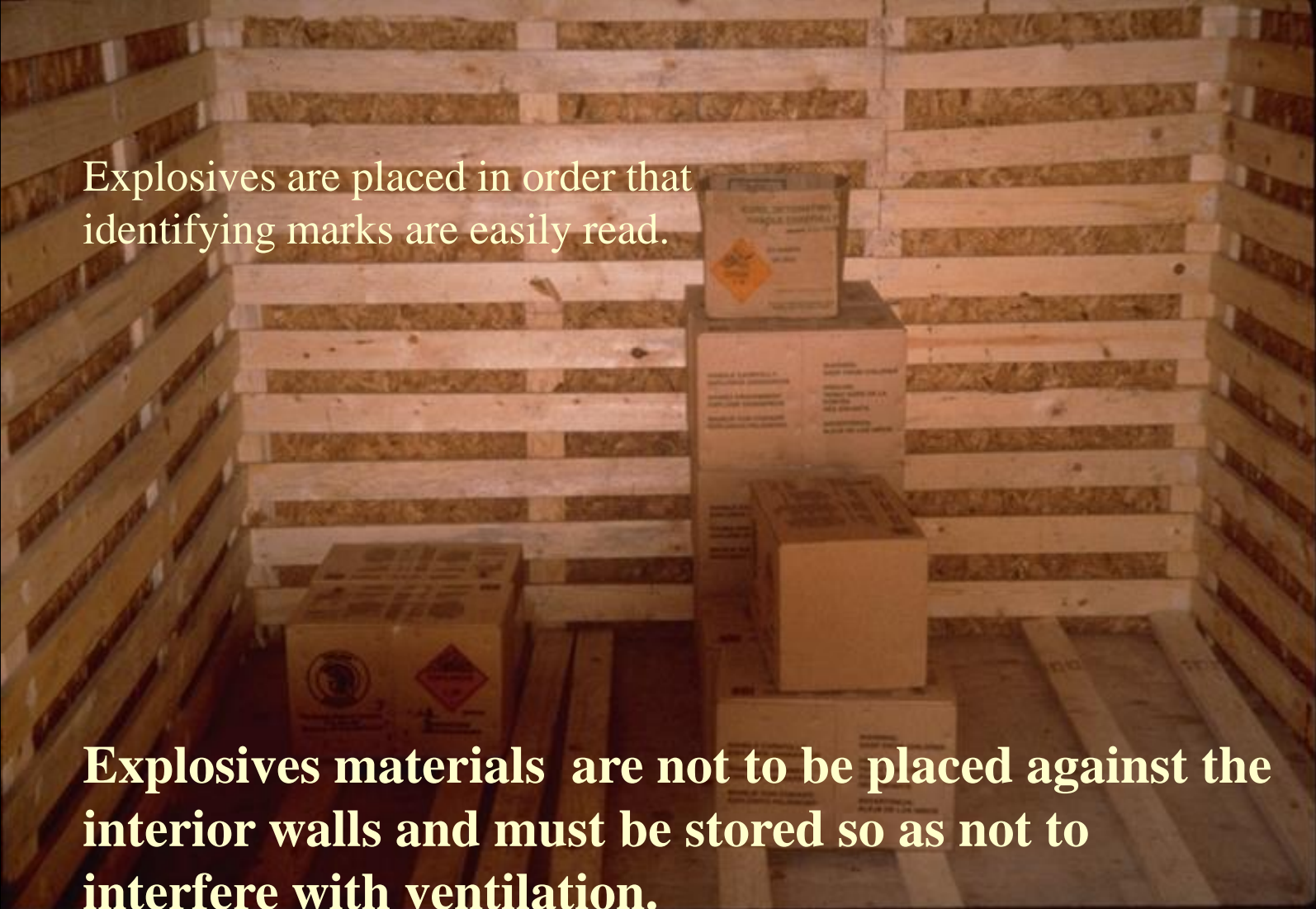


Storage Within Magazines

When any explosive has deteriorated to an extent that it is in an unstable or dangerous condition, or if nitroglycerin leaks from any explosives, then the person in possession of such explosive shall immediately proceed to destroy such explosive in accordance with the instruction of the manufacturer. Only experienced persons shall be allowed to do the work of destroying explosives.

Storage Within Magazines

When magazines need inside repairs, all explosives shall be removed and the floors cleaned. In making outside repairs, if there is a possibility of causing sparks or *fire* the explosives shall be removed from the magazine. Explosives removed from a magazine in order for repair shall either be placed in another class appropriate magazine or placed a safe distance from the magazine where they shall be properly guarded and protected until repairs have been completed, when they shall be returned to the magazine.



Explosives are placed in order that identifying marks are easily read.

Explosives materials are not to be placed against the interior walls and must be stored so as not to interfere with ventilation.

Storage



- Open and inspect magazine at least every 7 days to check for any unauthorized entry.
- Explosive materials shall be physically counted at least monthly. (Inventory)

Inventory and Responsibility



All explosives shall be accounted for at all times. Explosives not being used shall be kept in a locked magazine, unavailable to persons not holding a valid permit.

The employer shall maintain an **inventory and use record of all explosives.**

Blasters shall record any receipt or return of explosives on inventory records within the magazine.

Inventory and Responsibility

Physically counted at least monthly.

Detonators shall be inventoried as individual units.

Cartridge explosives shall be inventoried as pounds when in unopened cases, and as individual cartridges when in opened cases.

In case of any theft or loss, immediately notify:

Federal Bureau of Alcohol, Tobacco and Firearms

Division of Oil and Public Safety

local law enforcement agencies

MAGAZINE

Pyramid high explosives

DATE OF LAST TRANSACTION 20150308

BLASTER SIGNATURE:

M Lund

DATE: 20150318

Explosive Type	Date Code	Beginning Balance		Amount Received		Amount Removed		Amount Returned		Ending Balance	
		Case	Indv.	Case	Indv.	Case	Indv.	Case	Indv.	Case	Indv.
Pentex DUO 32	21-Aug-12	23								23	
Dyno 2# twinplex	18-Feb-08	23				1				22	
Pentex MP 908	30-Jy-12	76								76	
Spartan 900	28-JY-14	32								32	
Spartan 900	04-AU-14	65								65	
Snow Slugger BSP	21-Jan-11		7								7
Snowlaunchers	12-Jan-05	1								1	
Emuline	4-Nov-04	3								3	
Snowlauncher S stub	various Nov-07	14								14	
Dynomix 20#	10-Nov-08		15								15
Anfomix 50#	29-Sep-09		47				4				43
Special 40 Grain Det	13-Jul-99		4								4
Special 50 Grain Det	25-Oct-99		4								4

Sample of transaction log

Blast Records



A record of each blast shall be kept.

All records shall be retained at least five years, and shall contain at least the following minimum data:

Name of company or contractor;

Date, time and location of route;

Name, permit number and signature of blaster-in-charge;

Number of charges used on each route;

DAILY BLAST REPORT

Blaster in Charge <i>M. SPAND</i>				Permit Number <i>3936</i>					
Blaster's Signature <i>[Signature]</i>				Date of Blast(s) <i>20150117</i>		Time of Blast(s) <i>09:45</i>			
Method of Initiation <u>CAP-FUSE</u>				Weather Conditions <i>0, C, NIL</i>					
Explosives Received	Cast Primers <i>24</i>	Cap/Fuse <i>24</i>	Blasting Agents <i>/</i>	#8 Caps <i>/</i>	Detonating Cord <i>/</i>	Other <i>/</i>			
Explosives Used									
Name of Route(s)	Cast Primers	Cap/Fuse	Blasting Agents	#8 Caps	Detonating Cord	Other			
AHSP	<i>24</i>	<i>24</i>	<i>/</i>	<i>/</i>	<i>/</i>	<i>/</i>			
Totals	<i>24</i>	<i>24</i>	<i>/</i>	<i>/</i>	<i>/</i>	<i>/</i>			
Explosives Returned	Cast Primers <i>/</i>	Cap/Fuse <i>/</i>	Blasting Agents <i>/</i>	#8 Caps <i>/</i>	Detonating Cord <i>/</i>	Other <i>/</i>			
Misfires: <table border="1" style="display: inline-table; vertical-align: middle;"> <tr> <td style="text-align: center;">Yes</td> <td style="text-align: center;">No</td> </tr> </table>								Yes	No
Yes	No								
Location:									
Method of Disposal:									
Date of Disposal:									

Sample of blast report

Blast Records

Names of employees on each route;

Types of explosives used;

Total amount of each explosive used;

Method of initiation;

Type of Blasting (hand charge, cornice control, avalauncher)

Weather conditions; and

Statement noting any misfires, the location of misfires, steps taken to recover and dispose of any misfires, the date the misfire was found and disposed of.

Avalanche Control

General Requirements

The use of explosives for avalanche control shall comply with Article 7 of the Colorado Regulations.

Only blasters shall assemble, arm explosive components, and detonate explosive charges.

Each avalanche control blasting crew or team shall consist of a blaster and at least one trained assistant. The crew may consist of two blasters, but only one shall act as the blaster in charge.

Untrained personnel may accompany the blasting crew for training purposes but shall not participate in actual firing of charges until completion of training.

Avalanche Control

General Requirements

The blaster in charge of each crew or team shall be responsible for all decisions made regarding preparation and placement of charges.

Blasting operations shall be conducted during periods of daylight when the danger zone adjacent to the blast area is clearly visible to the blaster in charge and with personnel guarding the area, or when the area has been closed.

Night time blasting operations shall be approved by the Director of the Division of Oil and Public Safety, and approval shall only be granted if such approval serves the safety of the general public.

The blaster in charge shall preplan the escape route and all crew members shall understand the plan before igniting the charge.

No person shall accept or be given a job assignment which is beyond the individual's physical ability, training, or qualifications.

Cold temperatures, high winds, and heavy snowfall are conditions that should be anticipated in avalanche control blasting. These conditions shall be considered in determining a person's physical ability, training, and qualifications for conducting safe blasting operations, and in the management of safe blasting operations.

Training Requirements

- Blaster-in-training program:
- Minimum of **8 hours of classroom** education and a written exam
- Simulated field training charges for hand charges

Training Requirements

**Field experience training for hand charges
for blaster-in training:**

Observe 5 routes or deployment of 20 charges

Assist with deployment of 20 charges

**Initiate and deploy 20 charges under the direct
supervision of a blaster**

Construction of Make-up Rooms



interior construction non-sparking material

well ventilated with the ventilation system discharging to the outside of the make-up room.

The make-up table or area shall be located away from the area where explosives are kept before and after assembly.

theft resistant

Make-up Room Restrictions



Dust-proof and explosion-proof heating and lighting fixtures must meet National Electric Code standards.

All wiring must be sealed in conduit.

Smoking, matches, open flames, or flame or spark producing devices shall not be permitted inside the make-up room.

Flammable liquids or flammable compressed gases cannot be stored or had in the make-up room.

Make-up Room Restrictions



The occupancy of make-up rooms is restricted to only those authorized and trained personnel required to assemble cap and fuse or arm charges.

The make-up room cannot be used for the storage of unattended armed charges

All explosives stored inside the make-up room must be stored in at least a indoor Type 2 magazine.

Make-up Room Housekeeping

Keep clean and orderly.

Metal tools cannot be stored or used

- **Brooms** - non-sparking materials.
- Sweepings and **empty boxes** shall be disposed of as recommended by the manufacturer. (**burned**)
- Keep make-up bench free of any materials not used in the assembly of the charges.

Use of Explosives



While explosives are being handled or used, smoking, matches, or any other source of fire or flame shall not be within 50 feet of the blast site.

No person shall handle explosives while under the influence of intoxicating liquors, narcotics, or other dangerous drugs. This rule does not apply to persons taking prescription drugs and/or narcotics as directed by a physician providing such use shall not endanger the workers or others.

Use of Explosives

Blasters conduct blasting operations shall take every reasonable precaution, including but not limited to warning signals, flags and barricades to insure the safety of the general public and workers.

The blaster shall suspend all blasting operations and remove all persons from the blast site during the approach and progress of an electric storm.

No fire shall be fought where the fire is in imminent danger of contact with explosives. All employees shall be removed to a safe area and the fire area guarded against intruders.

Explosives Standards



Explosives shall have a shelf life of at least one operating season in the storage facilities in which it will be stored.

Explosives chosen must have an excellent water resistance and capable of detonation in cold temperatures.

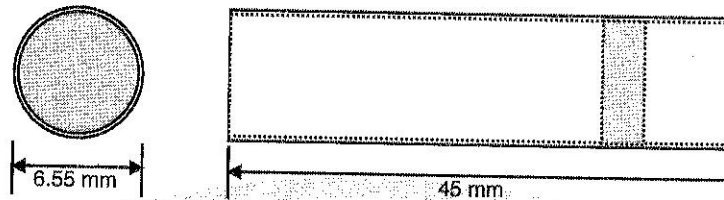


Blasting caps must be at least a No.6 cap and no larger than a No. 8 cap except when recommended by the explosives manufacturer for a particular explosive used within a specific application.



MANTESPO

Number 6 and 8 Detonator
(Plain Blasting Cap)



no. 6 caps
compared to
no. 8 caps

DETONATOR SPECIFICATIONS

Explosive Charge #8 : 800 mg
Explosive Charge #6 : 600 mg
Primary Charge : PETN (550 #8 or 350 #6)
Initiating Charge : Lead Azide (250 mg)
Shell Material : Aluminum
Shell OD : 6.55 mm
Shell Length : 45 mm
Min. Free Height : 24.9 mm



Detonating cord used for initiating primers must be at least a 25 grain cord.

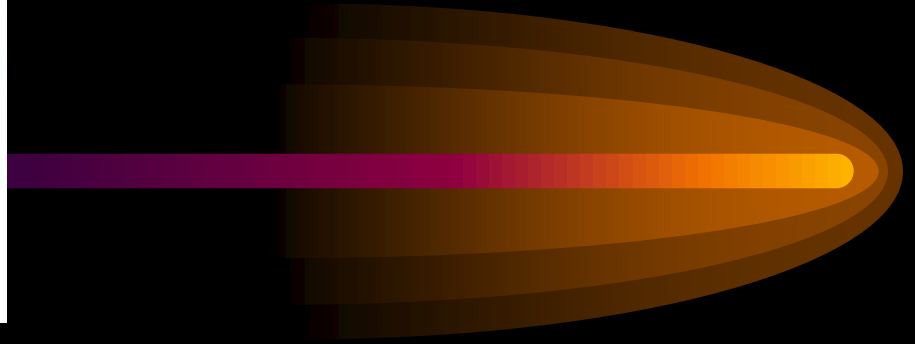
Explosives



Explosive materials that are damaged, show signs of deterioration, or have misfired shall not be used.

Detonators or explosives shall never be carried in pockets of clothing.

Should cartridges or packages of explosives show signs of discoloration or deterioration, such explosive material must be carefully set aside and properly disposed of according to the manufacturer's recommendations.



Only non-sparking metallic slitters may be used for opening fiberboard boxes.



No explosive material shall be abandoned or left in any location for any reason, nor left in such a manner that they may easily be obtained by children or other unauthorized persons.

Safety Fuse



Hand Charges

Safety Fuse



Safety fuse that is deteriorated or damaged in any way shall not be used.

Before uncoiling the fuse be sure it is warm and flexible.

The hanging of fuse on nails or other projections which will cause a sharp bend to be formed in the fuse is prohibited.

Before capping safety fuse, a minimum of one inch shall be cut from the end of the supply reel so as to assure a fresh cut end in each blasting cap (fuse detonator).



**Only a bench or hand held cap crimpers designed for the purpose of crimping fuse detonators shall be used for attaching blasting caps to safety fuse.
Crimpers shall be kept in good repair and accessible for use.**

Attaching blasting caps to safety fuse



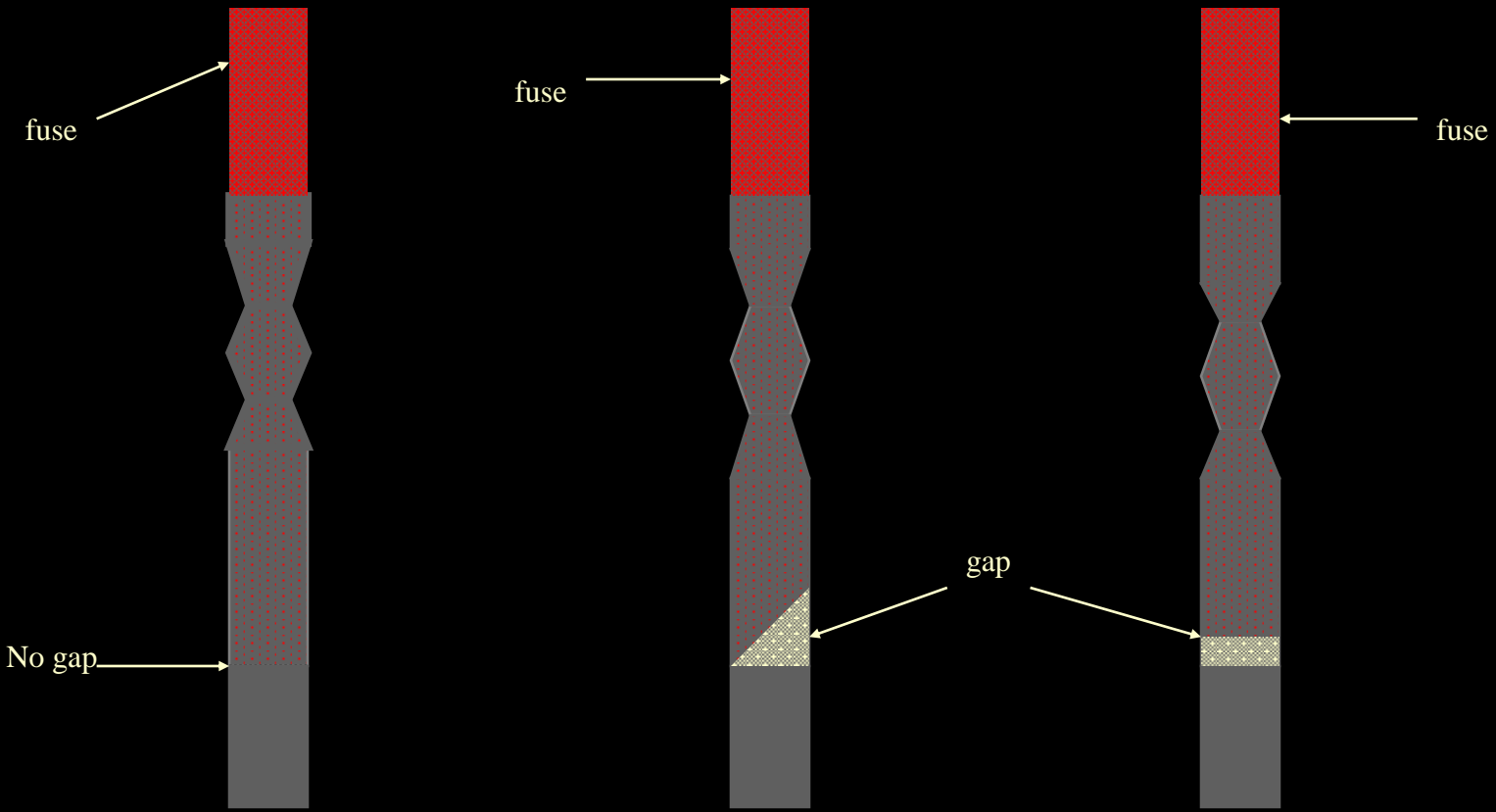
A square, clean cut will avoid smearing the waterproofing material over the powder train and help reduce the dud/misfire rate.

Gently insert the fuse into the blasting cap until the fuse butts against the cap wall--do not twist.

Crimp the end of the cap in two places as close to the end of cap as possible.

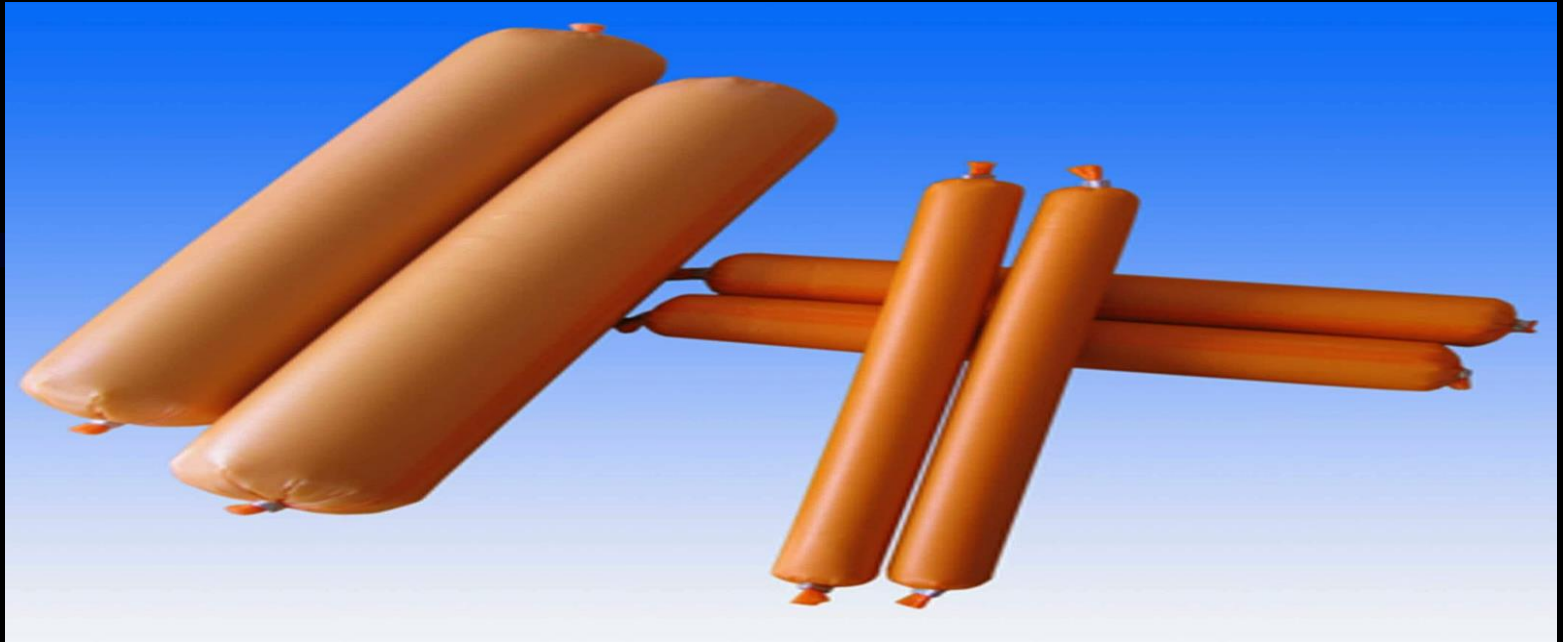
The crimp should be no more than 3/8” from the open/fuse end, non-explosive end of the blasting cap.

Slanting cuts increase the possibility of tapered ends folding over and blocking the end spit when inserted into the cap and prevents the seating of the fuse against the charge in the cap.



Right Way

Wrong Ways



When using emulsion products only non-sparking skewers shall be used for punching the hole in the cartridge to insert the capped fuse.

No blasting cap shall be inserted in the explosives without first making a hole in the cartridge of proper size or using a tool designed for that purpose. (standard crimpers)



**Assembling blasting caps and safety fuse
and pre-arming of charges
shall only be done in a warm, dry, well-lit make-up room.**

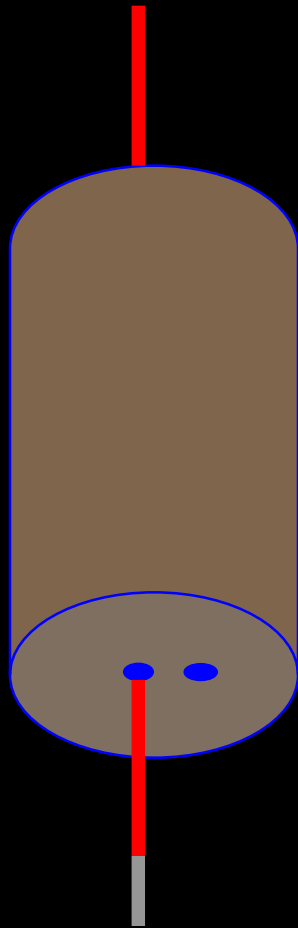
Hand Charges

Safety Precautions

No fuse detonators and fuse shall be assembled, or primers made up, in any magazine or near any possible source of initiation.

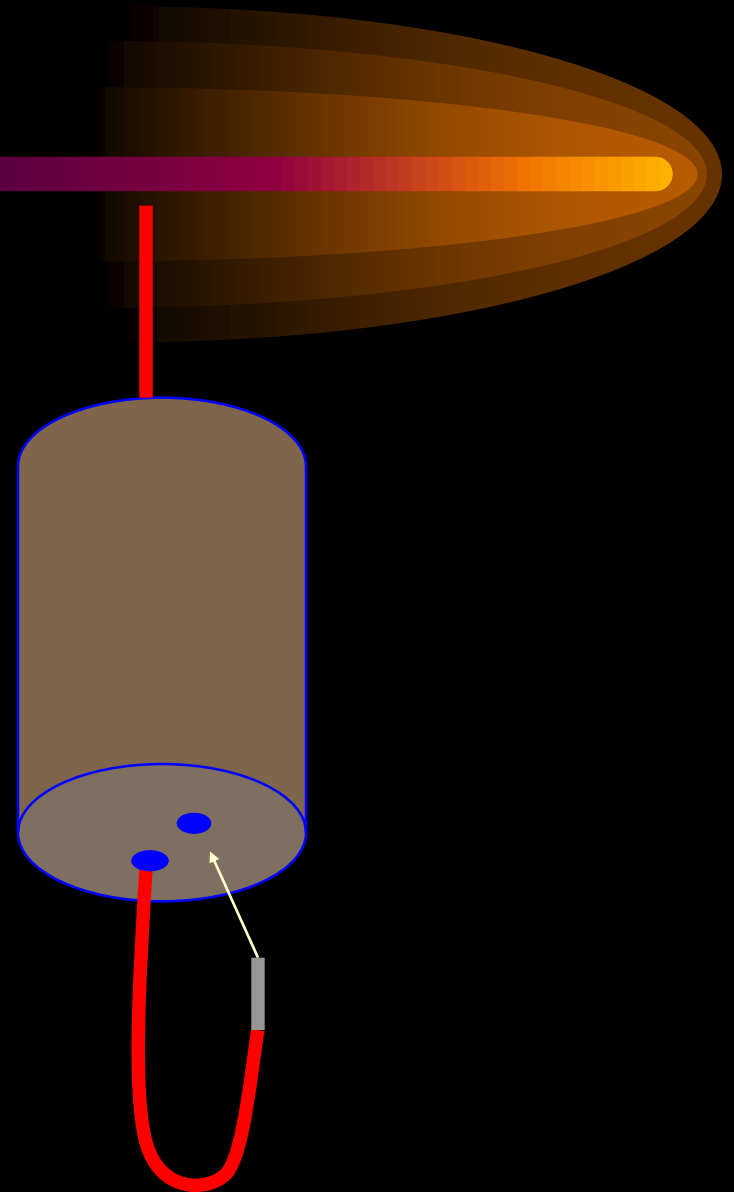
Detonators, cap and fuse assemblies, armed charges, or safety fuse igniters shall not be carried into nor stored in any magazine containing cartridge high explosives.

Arming a Cast Booster with a Single Cap and Fuse

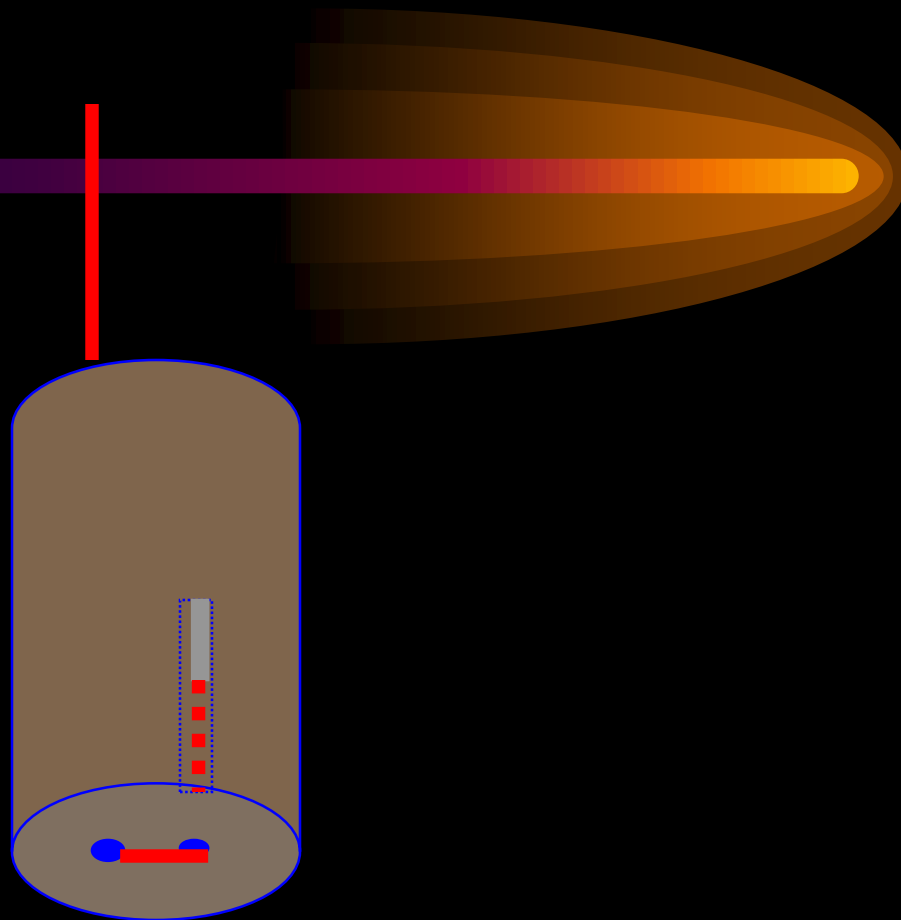


The explosive end of the cap
is inserted into the off-center hole.

Lace the fuse through the center hole,
gently pulling the fuse snug against the hole

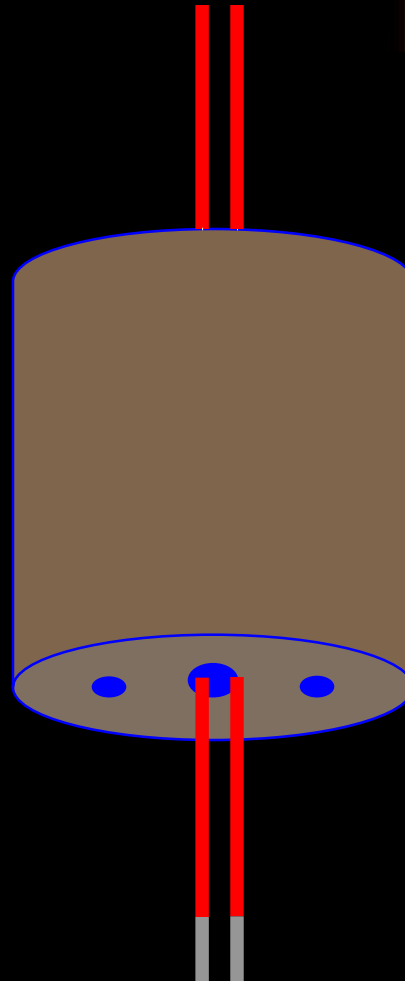


The assembly is taped securely to prevent the cap from being dislodged from the charge.

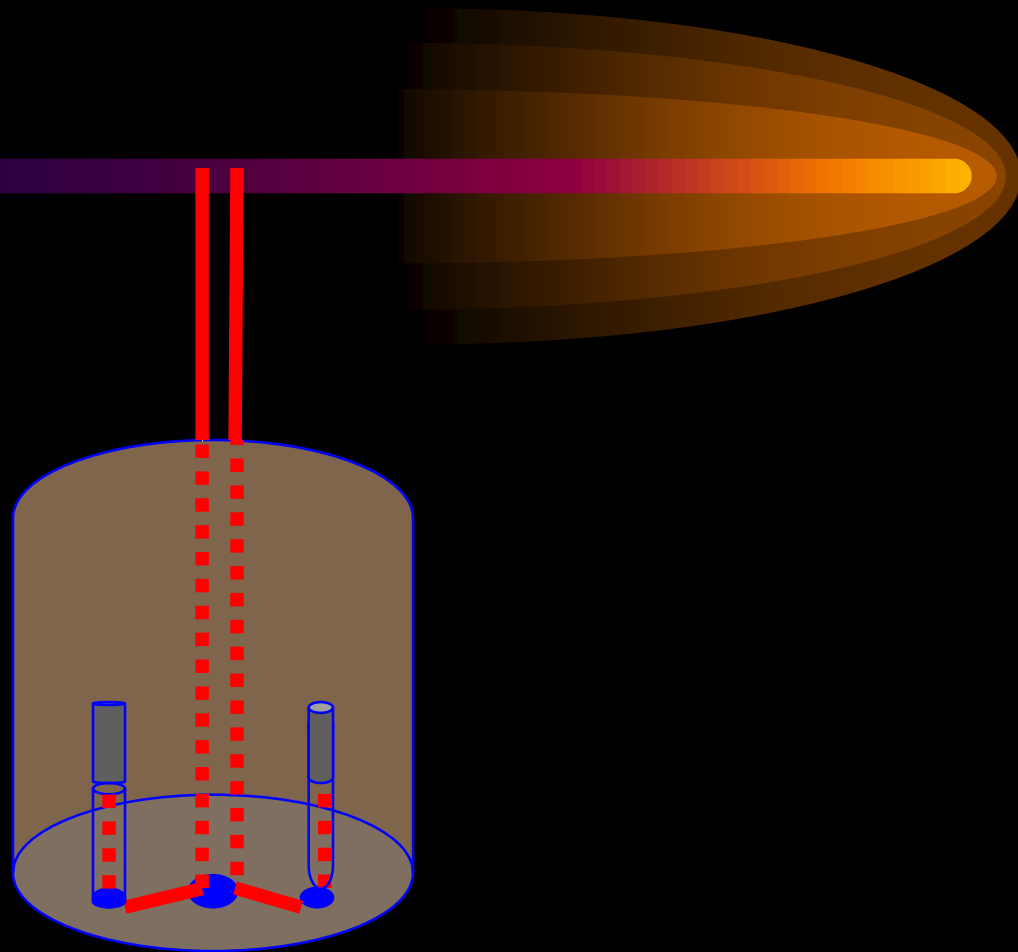


Arming the Twin Plex Cast Primer Two Caps

Insert explosive end of caps
into the center hole.



Insert caps into outside cap wells and secure the caps by taping the base of the charge.



Hand Charges

Arming of Charges with Detonators



Cast primers and boosters shall not be used if the hole is too small for the detonator, and attempting to enlarge the hole in a cast primer or booster shall not be permissible.

The detonator shall be secured within the primer so that no tension is placed on the safety fuse at the point of entry into the detonator.

Hand Charges

Arming of Charges



The detonator shall be fully inserted into the primer cartridge or booster and shall not protrude from the cartridge.

**After the cap and fuse assembly is inserted, the explosive contains a sensitive cap and is then vulnerable to premature detonation,
therefore delaying the arming of a charge until just before tossing the charge should be standard procedure when wind and/or temperatures are not severe.**

Hand Charges

Arming of Charges

When arming the charge at the blast site the blaster shall:

Make sure that the cap is installed on the correct length of fuse prior to transporting to blast sites.

Place caps in adequate protective padding or shields before placing in approved avalanche control packs.

Place caps and explosives in a separate approved avalanche control packs from explosives for while transporting to the blast site.

Hand Charges

Arming of Charges



Safety fuse igniters shall not be placed inside the pack when it contains explosives or detonators. but shall be carried in a separate compartment or separate pack.

Make sure that the detonator is secured to the charge before attaching fuse to the fuse igniter.

Hand Charges

Arming of Charges

Depending on weather conditions, charges may be armed in an make-up room as follows:

All caps shall be installed on the required length of fuse before the explosive cartridges or primers are brought to the make-up area.

Cap and fuse assemblies shall be secured correctly to each type of explosive charge being used.

Hand Charges

Arming of Charges

Cap and fuse assemblies shall not be attached to explosive charges until just before the time of distribution to patrol personnel.

Each hand charge shall be placed in an area separate from the assembly area immediately after assembly completed.

Distribution of hand charges into approved control packs shall take place away from the make-up area.

Preparing to blast

- 1) Plan your shot and your dud placement.
- 2) Always cinch pack drawstring tight and secure overflap down.
- 3) Always be prepared for flyrock. Expect it and be in a safe position well before planned detonation.
- 4) The igniter have 2 ferrules. A “grip ferrule” and a “stop ferrule.” Problems can arise with the grip ferrule- be prepared.
- 5) Ignition is possible by simply placing the igniter on the fuse.
- 6) By saying “arming,” this lets your partner know that you have trimmed the fuse.
- 7) “Fire in the hole” lets your partner and the world know that you are ready to place the igniter on the fuse.

Initiation of Hand Charges



- The length of fuse shall be 3 feet
- *or*
- have a burn time of not less than 120 seconds at the time of initiation.
- and shall be in accordance with manufacturer's recommendations

Initiation of Hand Charges

The lighting of fuse shall be done with hot-wire lighters or pull-wire igniters.

Matches, cigarette lighters, cigarettes, pipes, cigars or other unsafe means shall not be used to ignite fuse.

Igniters shall be used in accordance with manufacturer's recommendations and shall not be attached to a safety fuse until the charge is at the blast site and the crew is fully prepared to light the charge.

At least 2 persons shall be present when cap and safety fuse blasting is done by hand lighting methods.

Initiation of Hand Charges

- Always consider the **length** and **burning rate** of the safety fuse when planning a blast
- A sufficient time of **not less than 120 seconds**, with a margin of safety, shall always be provided for the blaster to reach a place of safety.

Initiation of Hand Charges



When the fuse lighter has been placed on the fuse, the blaster shall assume initiation of the safety fuse has occurred.

If the fuse does not show evidence of initiation, the blaster shall not attempt any further initiation of the charge but shall adequately mark the charge, and retreat with the blasting crew to a safe distance for not less than 1 hour.

Initiation of Hand Charges



After waiting at least one hour, the blaster in charge shall:

- 1) Determine that the initiation failed and ignite the uninitiated charge; or**
- 2) Determine that the initiation was successful and dispose of the misfired explosive charge with a secondary charge.**

Use of Detonating Cord

Handle with care and respect

Keep knots tight and keep all connections at right angles.

Do not damage or sever the cord.

Be sure the explosive core is dry when tying knots and making connections.

Use of Detonating Cord

Cut with a sharp knife, razor blade, or cutters designed for cutting detonating cord. Do not use scissors or plier type cutters.

All detonating cord connections shall be inspected before firing the blast.

When connecting a blasting cap to detonating cord:

Attach securely

Point the blasting cap the direction in which the detonation is to proceed.

Use of Detonating Cord



Initiation of detonating cord with cap and fuse requires two cap and fuse assemblies.

Detonators shall not be attached to the detonating cord until the area has been cleared for the blast.

Avalanche Control Packs



Water resistant.

Tools or other equipment shall not be placed in compartments containing explosives.

Each compartment used for hand charges or explosive components shall have an independent means of closure.

Avalanche Control Packs

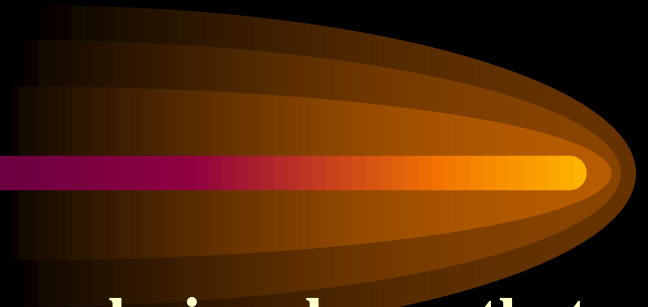
Inspect daily for holes, faulty compartments or closures, and explosive residue.

Keep adequately repaired and clean.

Do not leave packs containing explosives unattended

Individual control team members shall not carry more than thirty-five pounds of explosive material in avalanche control packs.

Misfires



An explosive charge or any part of an explosive charge that fails to detonate after initiation shall be considered a misfire.

The best way to handle a misfire is to prevent a misfire from occurring through the correct methods of cap and fuse assembly, primers assembly, and initiation of the charge.

If a misfire occurs, the blaster shall note the location of the misfired explosive, and shall not approach the misfired explosive for at least one hour.

Misfires



Explosives which are aflame or emitting smoke shall not be approached for at least 1 hour after evidence of combustion ceases.

The area shall remain guarded, or closed until a search of the area has been done and the misfire hazard is removed, or the blaster-in-charge pronounces the area safe.

Misfires shall be handled by the blaster-in-charge and only those employees necessary to remove the hazard or guard the area shall remain in the area.

Misfires

Caps and explosives recovered from misfires shall not be reused, but shall be disposed of in a manner recommended by the manufacturer.

Impact to explosive materials shall be avoided when searching for nonvisible misfired charges.

A hand charge and Avalauncher round misfires shall be disposed of where they are found with a secondary charge.

Transportation of Explosives on chairlifts when public is present

- Explosives shall be **attended at all times.**
- **Warning signs** shall be clearly posted at bottom of lift.
- Passengers shall not be allowed to ride in the opposing direction.

Transportation on Chairlifts

- A minimum distance of **200 feet** shall be maintained in front of and behind the chair transporting the explosives and chairs transporting the **public**.
- The amount of explosives shall not exceed 50 pounds.



Explosive Accident

- Big Sky ski patroller Erika Pankow, who was killed Christmas morning 1996 when she tried to re-light an explosive she thought was faulty.
- After the Big Sky accident, ski resorts were concerned their avalanche patrols would have difficulty getting explosives from manufacturers.