Mine Foreman Training

Proper Use and Handling of Explosives – Unit 4

Power Point Program and Training
Developed by Wayne Collett
Office of Mine Safety & Licensing
2005

351.107 Requirements for certification as shotfirer

(1) A person desiring to obtain experience as a shotfirer may not charge or detonate explosives in an underground mine unless he or she is under the direction and within sight and sound of a certified shotfirer. No person shall charge or detonate explosives within an underground mine unless that person has successfully completed a training program and passed a test administered by the department.

351.107 Requirements for certification as shotfirer (continued)

The test shall include at a minimum a determination of the person's ability to test for mine gases and to safely handle and detonate explosives in an underground coal mine. (2) The commissioner shall issue a shotfirer's certificate to the person upon successfully passing the test.

351.1071 Certification as shotfirer and driller for solid blasting

(1) No person shall drill coal or detonate explosives within a mine using the method of shooting coal from the solid until that person successfully completes a training program administered by the department and has passed a test prescribed by the commissioner.

(2) No person shall be issued a certificate in accordance with subsection (1) of this section unless he or she presents valid evidence to the commissioner of having one (1) year of practical underground coal mine experience.

352.241 Explosives and blasting devices in mines.

(1) Explosives or detonators carried anywhere underground by any person shall be in containers constructed substantially of nonconductive material, maintained in good condition, and kept closed. (2) When explosives or detonators are transported underground in cars moved by means of a locomotive or rope, or in shuttle cars, they shall be in substantial covered cars or in special substantial covered containers used specifically for transporting detonators or explosives:

Transporting Explosives Underground

A battery powered scoop can be used to transport explosives underground if they are carried in a specially de-signed container for that purpose.

An approved container for transporting explosives underground.
The detonators and explosives are separated by a four inch partition.

Ash Trucking Company
C-3 Mine

Date : Jan 29, 1997

Victim : Surface Laborer (FATALITY)

Where : Harlan County

How : explosives accident

It was concluded that the accident occurred due to the failure of management to properly provide for the safe handling, transportation and storage of explosives. **Explosives were being hauled in the back of a pick-up truck. According to a co-worker, the victim had left the shop to get a pipe wrench which was in the truck. He walked to the bottom of the hill, drove the truck to the shop entrance, cut the engine off, got out of the truck, and was seen bent over at the truck bed when the explosion occurred.**

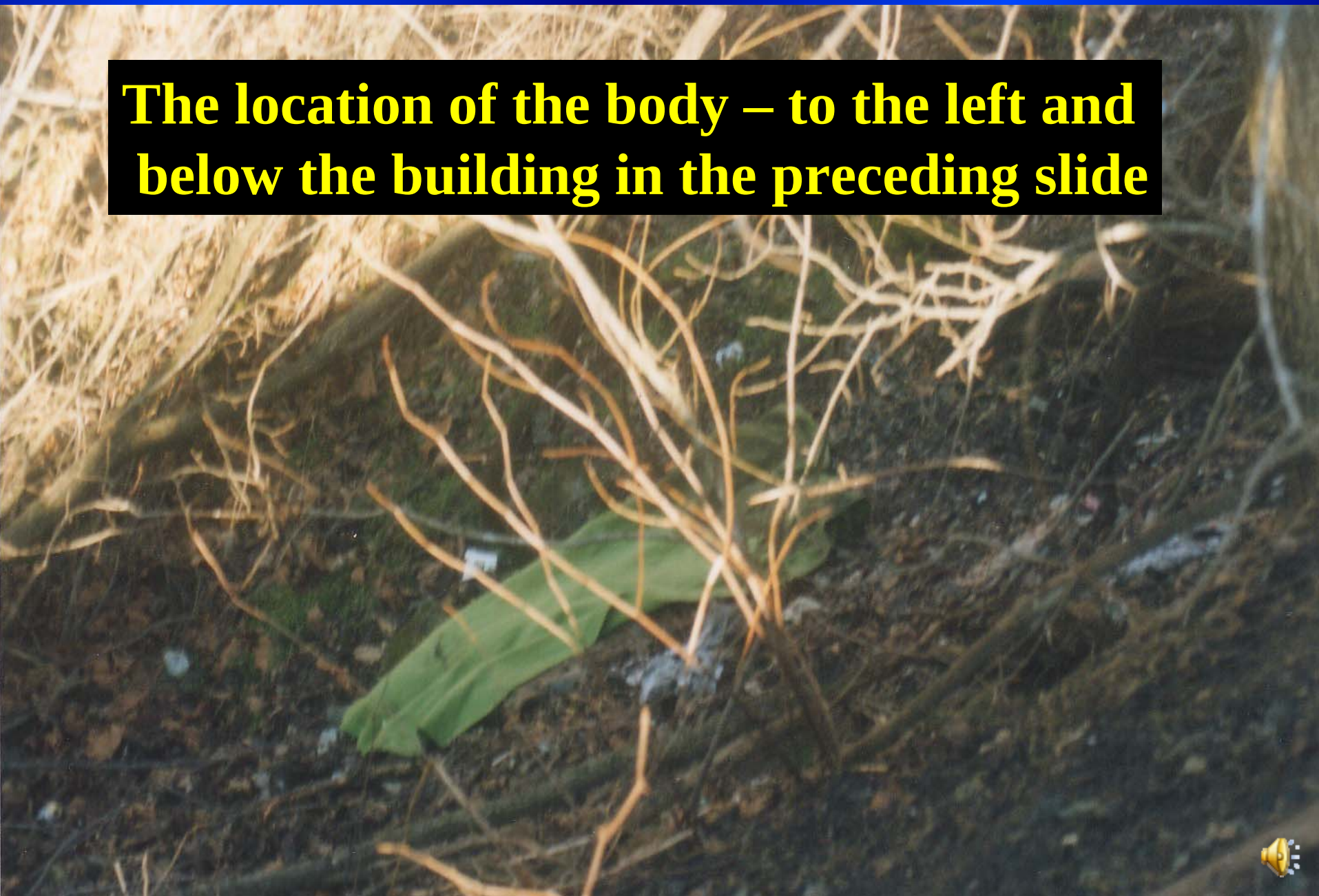
A rear view of the blown-up pickup truck

Another view of the accident scene


A view from the front of the pick-up truck
TOYOTA


A building to the left of the pick-up truck showing damage done by the explosion


A close up view of damage to the top of the building


The location of the body – to the left and below the building in the preceding slide

RECOMMENDATIONS

Separate surface magazines shall be provided for the storage of explosives and detonators.

An employer shall permit only authorized and qualified persons to handle and use explosives.

352.241 Explosives and blasting devices in mines.

(a) The bodies and covers of the cars and containers shall be constructed or lined with nonconductive material;

(b) If explosives and detonators are hauled in the same explosives car or in the same special container, they shall be separated by at least a four (4) inch substantially fastened hardwood partition or the equivalent;

352.241 (c) Explosives and detonators shall not be transported on the same trip with men.

352.241 Explosives and blasting devices in mines.

(c) Explosives, detonators, or other explosive items shall not be transported on the same trip with men. (d) When explosives or detonators are transported in special cars or containers in cars, they shall be hauled in special trips not connected to any other trip.

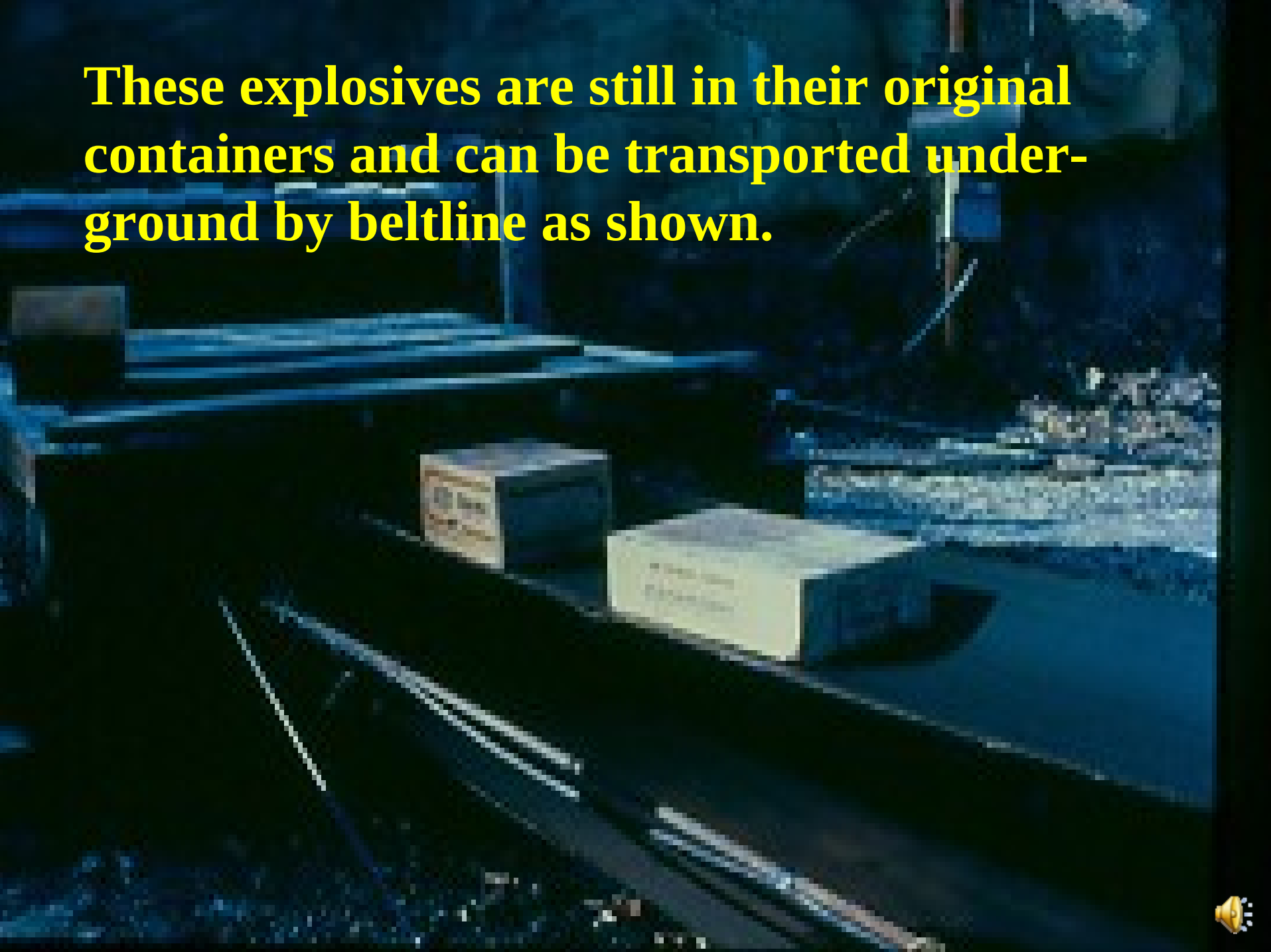
352.241 Explosives and blasting devices in mines.

(e) Explosives or detonators shall not be hauled into or out of a mine within five (5) minutes preceding or following a man trip or any other trip.

352.241 Explosives and blasting devices in mines.

(3) Explosives and detonators shall be transported underground by belt only under the following conditions:

(a) In the original and unopened case, in special closed cases constructed of nonconductive material, or in suitable individual containers;


These explosives are still in their original containers and can be transported under-ground by beltline as shown.

352.241 Explosives and blasting devices in mines.

(b) Clearance requirements shall be the same as those for transporting men on belts;

(c) Suitable loading and unloading stations shall be provided; and

(d) Stop controls shall be provided at loading and unloading points, and an attendant shall supervise the loading and unloading of explosives and detonators.

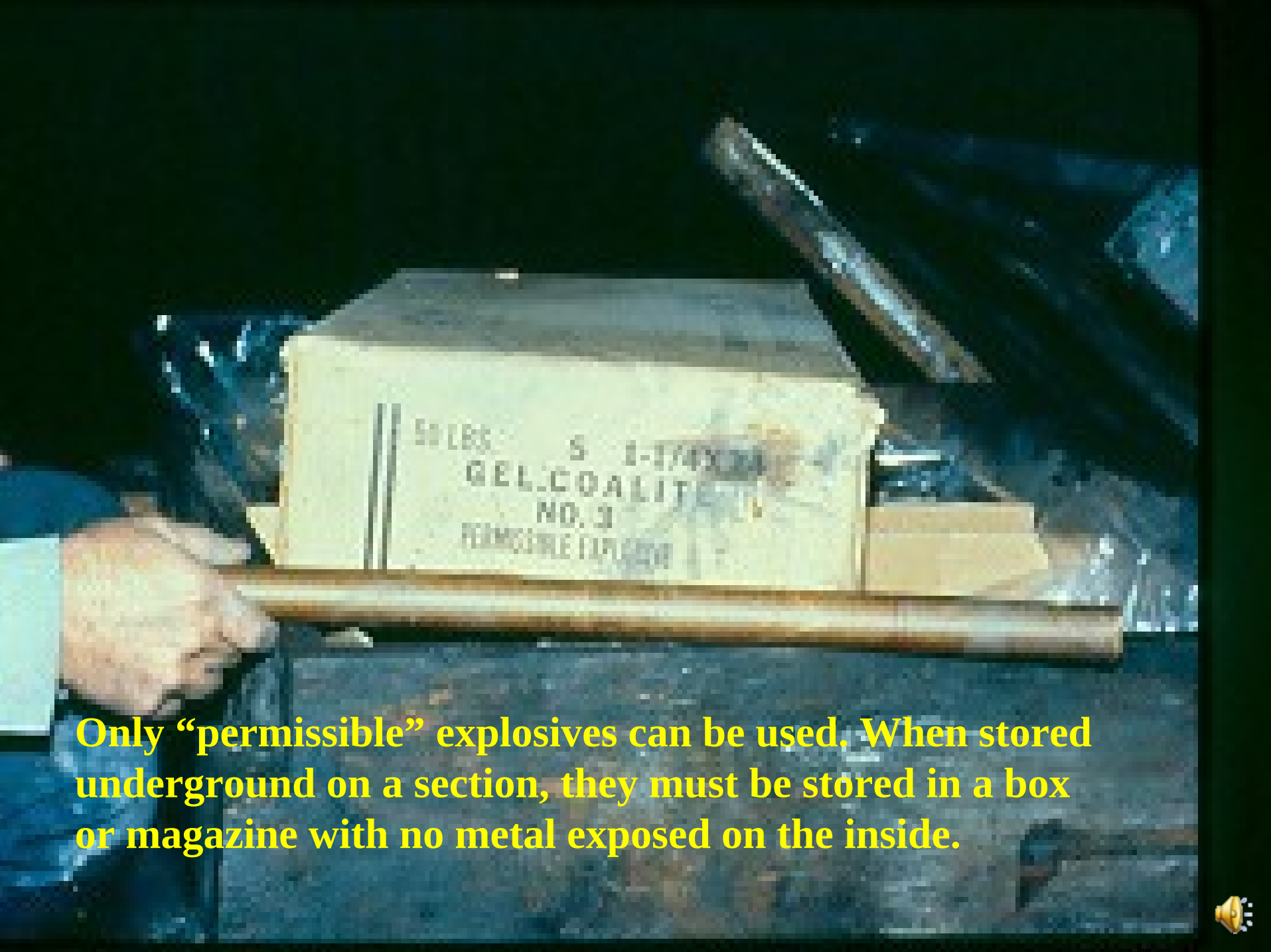
352.241 Explosives and blasting devices in mines.

(4) Neither explosives nor detonators shall be transported on flight or shaking conveyors, scrapers, mechanical loading machines, locomotives, cutting machines, track drills, or any self-propelled mobile equipment.

However, this does not prohibit the transportation of explosives or detonators in special substantial covered containers.

352.241 Explosives and blasting devices in mines.

(5) When supplies of explosives and detonators for use in one (1) or more sections are stored underground, they shall be kept in section boxes or magazines of substantial construction with no metal exposed on the inside, located at least twenty-five (25) feet from roadways and power wires, and in a reasonably dry, well-rock-dusted location protected from falls of roof.



Only “permissible” explosives can be used. When stored underground on a section, they must be stored in a box or magazine with no metal exposed on the inside.

352.241 Explosives and blasting devices in mines.

(6) When explosives or detonators are stored in the section, they shall be kept preferably in separate boxes or magazines not less than five (5) feet apart; if kept in the same box or magazine, they shall be separated by at least a four (4) inch substantially fastened hardwood partition or the equivalent. Not more than a forty-eight (48) hour supply of explosives or detonators shall be stored underground in any one (1) section in the boxes or magazines.

352.241 Explosives and blasting devices in mines.

(7) Explosives and detonators stored near the working faces shall be in separate closed containers, and shall be in a location out of line of blast not less than fifty (50) feet from the face and fifteen (15) feet from any pipeline, powerline, rail, or conveyor; except that if kept in niches in the rib, the distance from pipeline, powerline, rail, or conveyor shall be at least fifteen (15) feet. Explosives and detonators, when stored, shall be separated by a distance of at least ten (10) feet.

352.241 Explosives and blasting devices in mines.

(8) Explosives and detonators shall be kept in their containers until immediately before use at the working faces.

(9) Only nonmetallic tools shall be used for opening wooden explosives containers. Tools or other materials shall not be stored with explosives or detonators.

352.241 Explosives and blasting devices in mines.

(10) All explosives used underground in underground mines except in sinking shafts and slopes from the surface shall be of the permissible type, specifically designed and manufactured for underground use, and shall be used as follows:

(a) Fired only with electric detonators of proper strength; (b) Fired with a permissible shot-firing unit of adequate capacity to fire all caps; however, if firing is done from the surface when all men are out of the mine, the firing unit does not need to meet specifications of permissibility;

352.241 (10) Explosives and blasting devices in mines.

(c) Where the coal is cut, shots shall not be fired if the blast hole is drilled beyond the limits of the cut;

(d) Boreholes shall be cleaned, and they shall be checked to see that they are placed properly and are of correct depth, in relation to the cut, before being charged;

(e) All blasting charges shall have a burden of at least eighteen (18) inches in all directions if the height of the seam permits;

352.241 (10) Explosives and blasting devices in mines.

(f) Boreholes shall be stemmed with at least twenty-four (24) inches of incombustible material, or at least one-half (1/2) of the length of the hole shall be stemmed if the hole is less than four (4) feet in depth unless other permissible stemming devices or methods are used; (g) Examinations for gas shall be made immediately before firing each shot or group of multiple shots and after blasting is completed;

352.241 (10) Explosives and blasting devices in mines.

(h) Shots shall not be fired in any place where methane greater than one percent (1%) can be detected with approved gas detection devices when tested at a point not less than twelve (12) inches from the roof, face or rib;

352.241 (10) Explosives and blasting devices in mines.

(i) Charges exceeding one and one-half (1-1/2) pounds, but not exceeding three (3) pounds, shall be used only if boreholes are six (6) feet or more in depth, the explosives are charged in a continuous train, with no cartridges deliberately deformed or crushed, with all cartridges in contact with each other and with the end cartridges touching the back of the hole and the stemming respectively. However the three (3) pound limit does not apply to special solid rock work if the mine is evacuated or if approved by the department;

352.241 (10) Explosives and blasting devices in mines.

(j) Shots shall be charged and fired by certified shotfirers designated by the mine foreman;

(k) Boreholes shall not be charged while any other work is being done at the face, and the shot or shots shall be fired before any other work is done in the zone of danger from blasting except that which is necessary to safeguard the employees;

352.241 (10) Explosives and blasting devices in mines.

(l) Only nonmetallic tamping bars shall be used for charging and tamping boreholes. This does not prohibit the use of a nonmetallic tamping bar with a nonsparking metallic scraper on one (1) end;

(m) The leg wires of electric detonators shall be kept shunted until ready to connect to the firing cable;

352.241 (10) Explosives and blasting devices in mines.

(n) Shots shall not be fired from the power of signal circuit while any men are in the mine;

(o) The roof and ribs of working places shall be tested before and after firing each shot or group of multiple shots;

352.241 (10) Explosives and blasting devices in mines.

(p) Ample warning shall be given before shots are fired, and care shall be taken to ascertain that all persons are in the clear. Men shall be removed from adjoining working places when there is danger of a shot blowing through;

(q) Mixed types or brands of explosives shall not be charged or fired in any borehole;

(r) Mudcaps (adobes) or other unconfined shots shall not be fired underground in a mine;

352.241 (10) Explosives and blasting devices in mines.

(s) Before blasting, the continuity of the blasting circuits shall be tested with a permissible blaster's galvanometer specifically designed for this purpose;

(t) No instantaneous detonator shall be connected in a circuit containing short-period delay detonators. The first charge in a sequence shall be initiated by a short period delay detonator having a nominal delay period of not less than twenty-five (25) milliseconds;

352.241 (10) Explosives and blasting devices in mines.

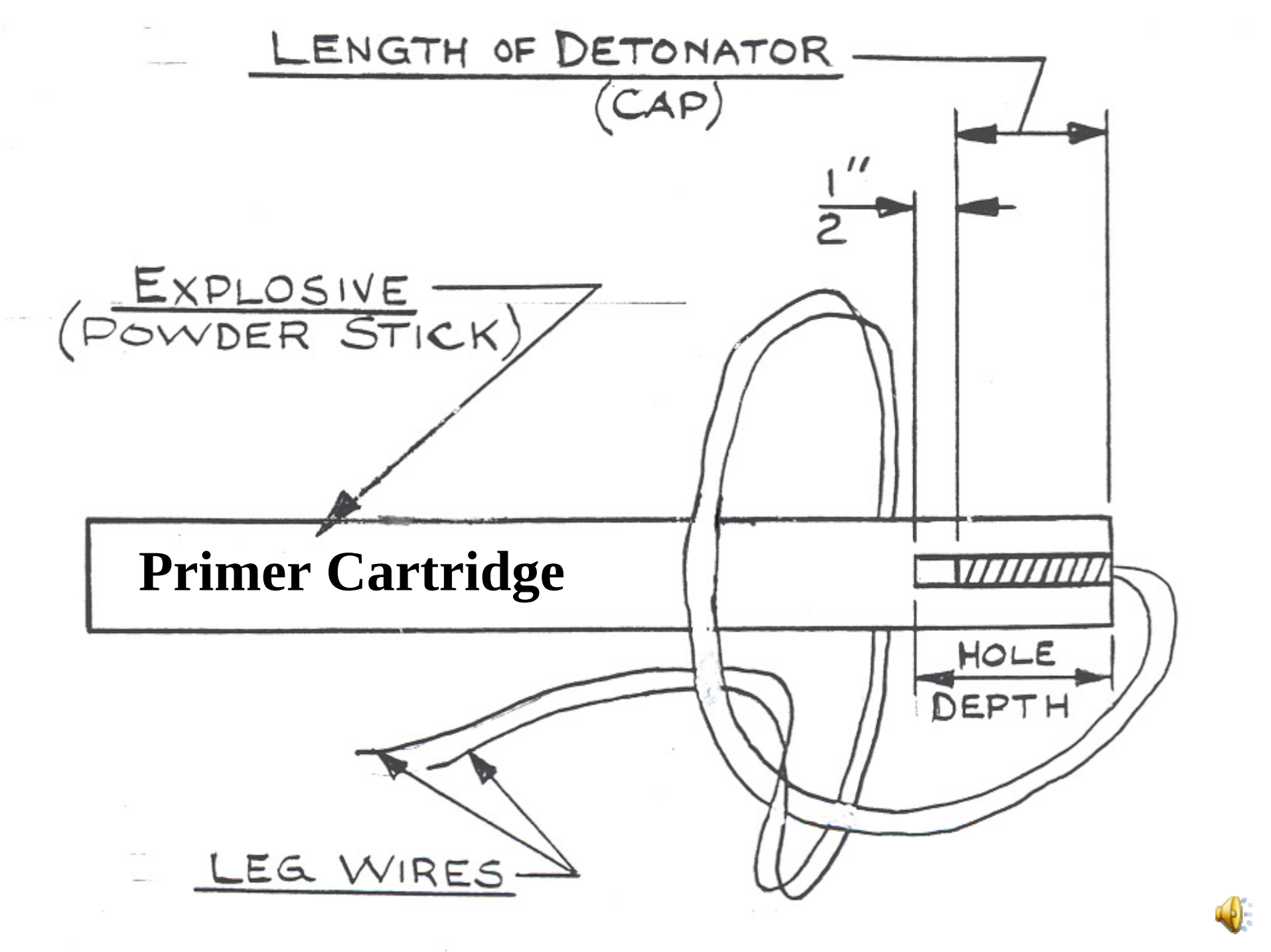
(u) All short period delay detonators shall be wired in series;

(v) Each primer shall be made with care to insure that the detonator is inserted properly and does not protrude from the wrapping and that the leg wires are secured to the cartridge in a manner so that the detonator will not become dislodged in handling and charging;

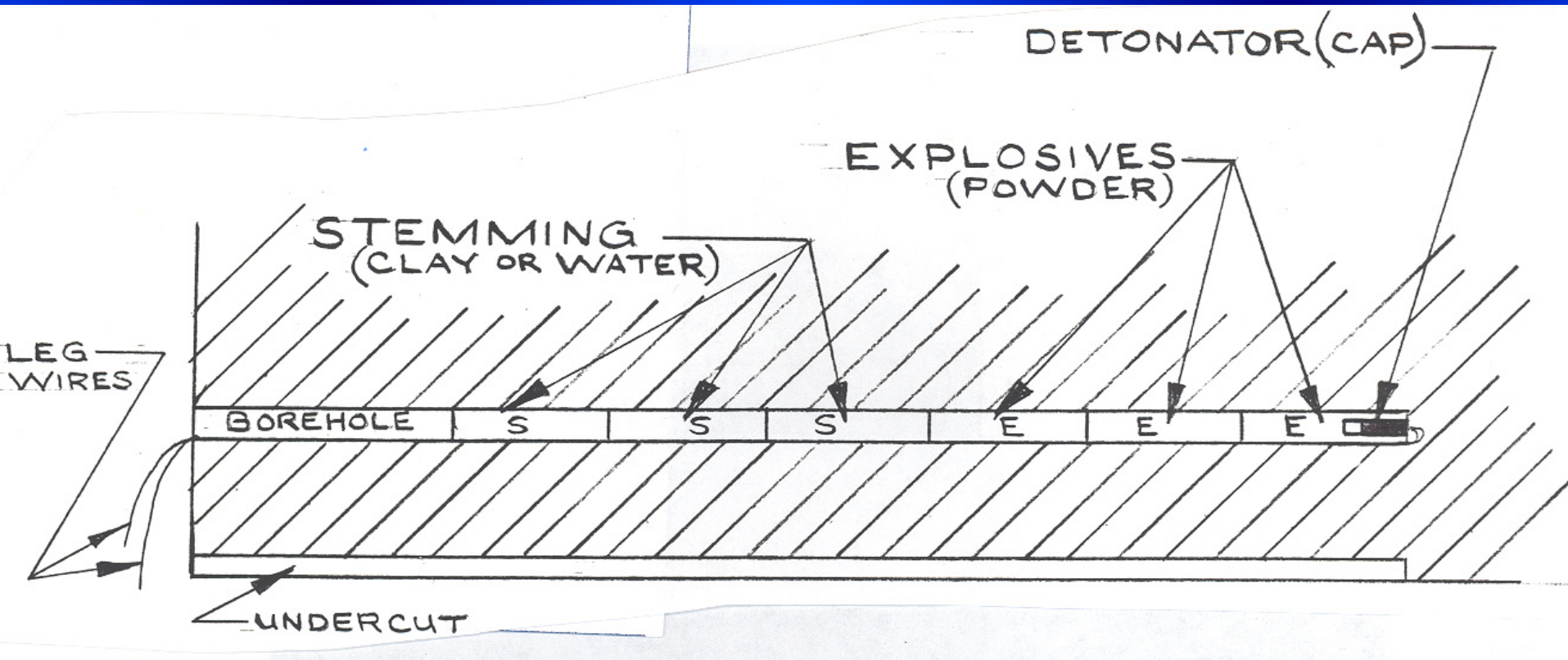
352.241 (10) Explosives and blasting devices in mines.

(w) In making a primer, a powder punch of nonsparking material shall be used. The hole in the cartridge shall be at least one-half (1/2) inch deeper than the detonator used. Rolling the end of a cartridge to receive a detonator is prohibited;

(x) The primer shall be placed in the borehole first pointing outward and the rest of the charge shall be pushed in a continuous train to the back of the borehole to prevent cuttings from getting between the cartridges; and


LENGTH OF DETONATOR
(CAP)
1"
2
EXPLOSIVE
(POWDER STICK)
Primer Cartridge
HOLE
DEPTH
LEG WIRES

A properly charged borehole



352.241 (10) Explosives and blasting devices in mines.

(y) Suitable clean-up of loose coal and coal dust with adequate rock-dusting or wetting down at the face of each working place shall be completed prior to charging shot holes.

352.241 Explosives and blasting devices in mines.

(11) Blasting cables shall be:

(a) Well insulated and as long as may be necessary to permit the shotfirer to get in a safe place around a corner;

(b) Short-circuited at the battery end until ready to attach to the blasting unit;

352.241 Explosives and blasting devices in mines.

(c) Staggered as to length or the ends kept well separated when attached to the detonator leg wires; and

(d) Kept clear of power wires and all other possible sources of active or stray electric current.

352.241 Explosives and blasting devices in mines.

(12) Where misfires occur with electric detonators, a waiting period of at least five (5) minutes shall elapse before anyone returns to the shot. After the failure, the blasting cable shall be disconnected from the source of power and the battery ends short-circuited before electric connections are examined.

352.241 Explosives and blasting devices in mines.

(13) Explosives shall be removed by firing a separate charge at least two (2) feet away from, and parallel to, the misfired charge or by washing the stemming and the charge from the borehole with water, or by inserting and firing a new primer after the stemming has been washed out.

352.241 Explosives and blasting devices in mines.

(14) A very careful search of the working place, and, if necessary, of the blasted material after it reaches the surface shall be made after blasting a misfired hole, to recover any undetonated explosive.

(15) The handling of a misfired shot shall be under the direct supervision of the mine foreman or a competent person designated by him.

352.251 Magazines for storage explosives -- Requirements for construction and operation.

(1) Separate surface magazines shall be provided for the storage of explosives and detonators.

(2) Surface magazines for storing and distributing explosives in amounts exceeding one hundred twenty-five (125) pounds shall be:

352.251 Magazines for storage explosives -- Requirements for construction and operation.

(a) Reasonably bulletproof and constructed of incombustible material or covered with fire-resistive material. The roofs of magazines so located that it is impossible to fire bullets directly through the roof from the ground need not be bulletproof, but where it is possible to fire bullets directly through them, roofs shall be made bullet-resistant by material construction, or by ceiling that forms a tray containing not less than a four (4) inch thickness of sand, or by other methods;

352.251 Magazines for storage explosives -- Requirements for construction and operation.

(b) Provided with doors constructed of three-eighths (3/8) inch steel plate lined with a two (2) inch thickness of wood, or the equivalent;

(c) Provided with dry floors made of wood or other nonsparking material and have no metal exposed inside the magazine;

(d) Provided with suitable warning signs so located that a bullet passing directly through the face of a sign will not strike the magazine;

352.251 Magazines for storage explosives -- Requirements for construction and operation.

(e) Provided with properly screened ventilators;

(f) Equipped with no openings except for entrance and ventilation;

(g) Kept locked securely when unattended.

(3) Surface magazines for storing detonators shall be in accordance with other provisions for storing explosives.

352.251 Magazines for storage explosives -- Requirements for construction and operation.

(4) The location of magazines shall be not less than two hundred (200) feet from any mine opening, occupied building, or public road. Where compliance with this provision is not practicable, the magazine shall be effectively barricaded. Where practicable, as determined by the mine inspector, future explosives magazines shall be placed in open pits, ravines or other recessed areas.

352.251 Magazines for storage explosives -- Requirements for construction and operation.

(5) The supply kept in distribution magazines shall be limited to approximately one (1) day's requirements, and such supplies of explosives and detonators may be distributed from the same magazine, if separated by at least a four (4) inch substantially fastened hardwood partition or the equivalent.

352.251 Magazines for storage explosives -

(6) The area surrounding magazines for not less than twenty-five (25) feet in all directions shall be kept free of rubbish, dry grass, or other materials of a combustible nature.

(7) Only permissible lights, worn or carried, shall be used inside magazines.

(8) Only nonmetallic tools shall be used for opening wooden containers. Extraneous materials shall not be stored in an explosives or detonator magazine.

(9) Smoking, carrying smokers' articles, or open flame shall be prohibited in or near any magazine.

352.260 Shotfirers -- Solid blasting.

(1) Any operator of a mine shall designate only certified persons as shotfirers to prepare the cartridge and set off and discharge the shots.

(2) Shotfirers shall at all times be under the direction of a certified mine foreman.

(3) The following conditions apply when shooting coal from the solid:

(a) All licensees engaged in shooting coal from the solid shall submit an application for a permit to the commissioner on a form prescribed by the department.

352.260 Shotfirers -- Solid blasting.

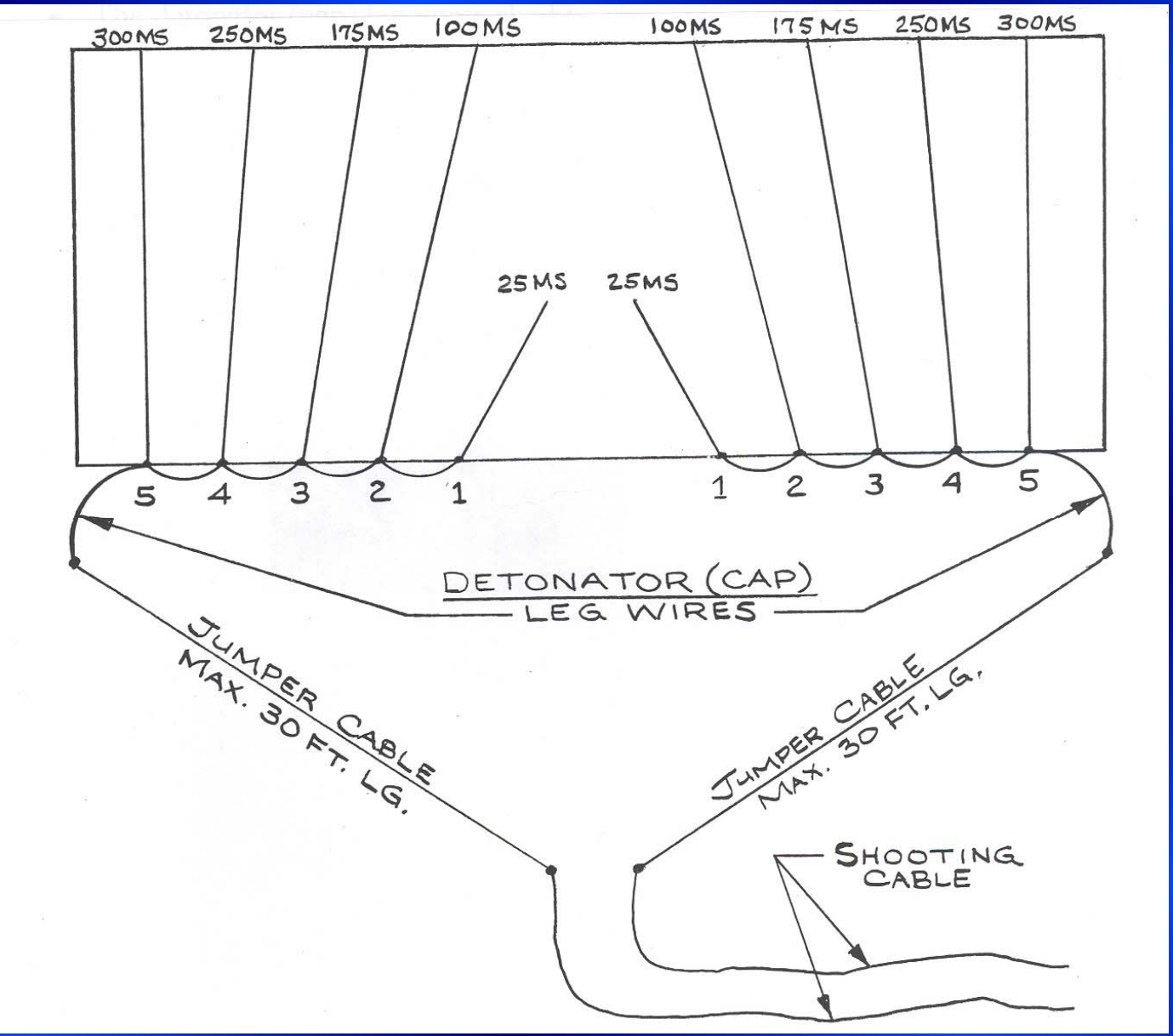
(b) Before said permit is issued by the commissioner he shall have an investigation conducted of the mine to determine the adequacy of the proposed solid blasting plan in complying with KRS Chapter 351 and this chapter and administrative regulations applicable to blasting coal in an underground mine.

(c) The mine inspector shall have the authority to stop production at the mine by the issuance of a closure order to any operator who fails to obtain a permit when shooting coal from the solid.

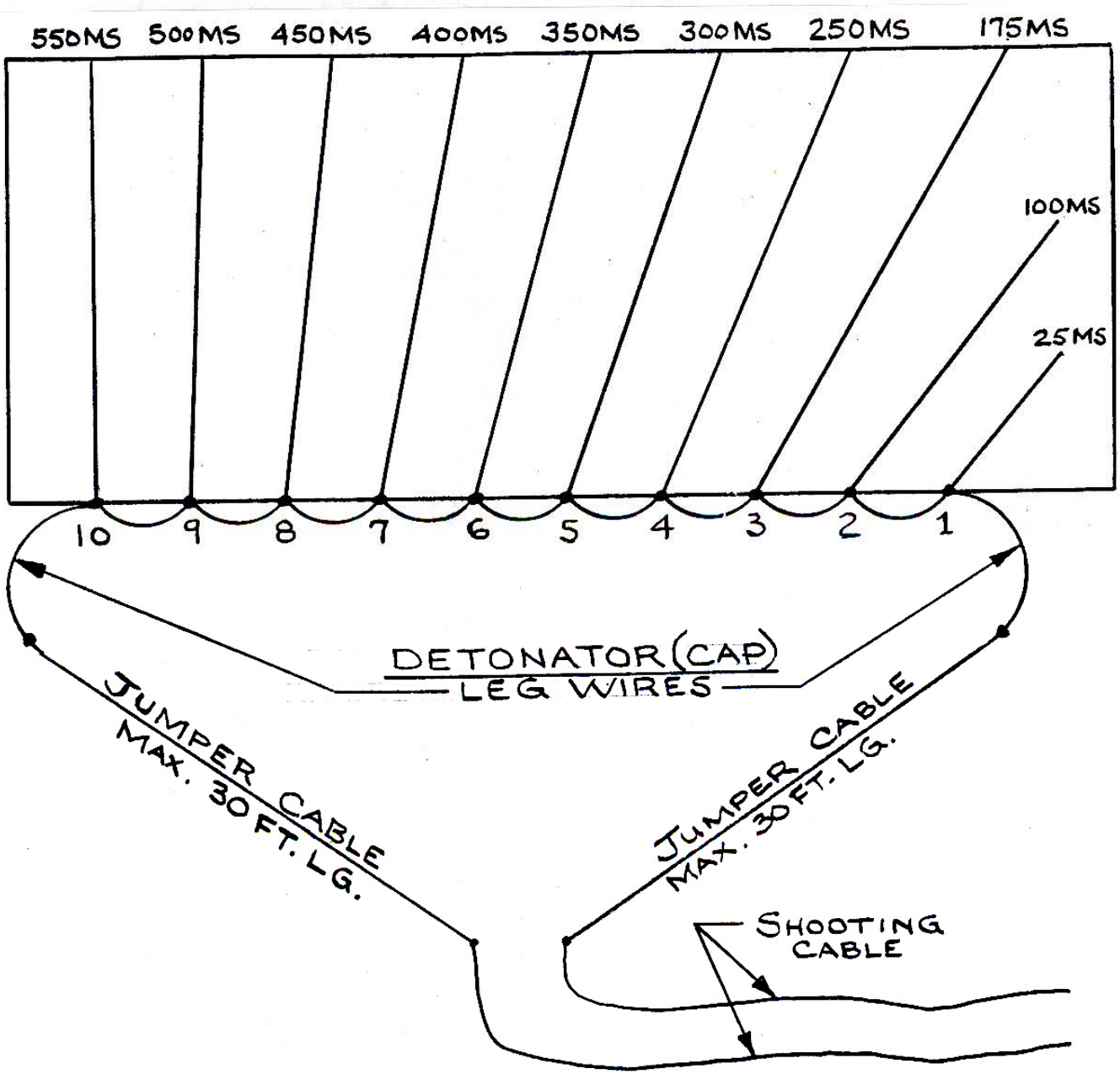
352.260 Shotfirers -- Solid blasting.

(4) When using the method of solid blasting, no more than one (1) face shall be charged or detonated simultaneously.

(5) When shooting coal from the solid, not more than two (2) adjacent openers or cut holes shall be primed with detonators having the same delay period. The nominal delay intervals between the succeeding rows of horizons shall not be less than fifty (50) milliseconds nor more than one hundred (100) milliseconds.



Typical hole pattern for a "V – Cut" in Solid Shooting



Typical hole pattern for a "Slab Cut" in Solid Shooting

Oral Exam Explosives

What is the only kind of explosive that can be used in an underground coal mine?

Permissible explosives and permissible blasting devices.

How must a permissible explosive be fired?

Only with electric detonators of proper strength.

What is the maximum charge of permissible explosive for a hole (six) 6 ft. or more in depth?

Answer: three (3) pounds

What is the maximum charge of permissible explosive for a hole less than six (6) ft. in depth?

Answer: one and one half ($1^1/_2$) pounds

How must permissible explosives be stemmed?

Answer: they must be properly confined in a hole with incombustible stemming material of the following lengths:

(1) At least 24 in. long; or

(2) One-half the length of the hole if the hole is less than 4 ft. in depth

What must be done immediately before the shot is detonated?

The place must be checked for gas and the methane content must be less than 1% and excessive coal dust must not be present.

What may be the result of using permissible explosives in a non-permissible manner?

Any of the following can occur: an ignition of methane/air/dust mixture, misfire, blowout, or a premature ignition.

What is the principal cause of explosives accidents when permissible explosives are used?

Answer: Carelessness or improper use

What poisonous gases are liberated by explosives when fired?

Answer: carbon monoxide and oxides of nitrogen.

How shall explosives and detonators be transported into a mine?

They shall be enclosed in non-conductive boxes and transported separately from firing devices.

If explosives and detonators are to be hauled on the same trip, how shall they be kept in relation to each other?

They shall be separated by substantially fastened hardwood partitions, at least 4 in. thick, or by a construction providing equivalent safety protection.

How may explosives be hauled by electrically operated trips?

In covered cars or containers that are substantially well built and lined with non-conductive material.

What are the provisions related to carrying explosives on trips which transport workers?

Explosives are prohibited on trips which carry workers.

At what time interval should explosives trips precede or follow any other trip?

They should be not less than five minutes apart.

What supplies may not be hauled in the same trip with explosives?

Oil, grease or other highly flammable materials.

How may explosives and detonators be transported by belt conveyors?

Only in the original, unopened case or in enclosed, insulated containers.

Where explosives and detonators are transported by belt conveyor, what must be provided at loading and unloading points?

Stop controls must be provided and an attendant shall supervise the loading and unloading of supplies.

What types of equipment are illegal to use for the transportation of explosives and detonators?

Flight conveyors, continuous mining machines, loading and cutting machines, and drills.

How much clearance is required where explosives are transported on a belt conveyor?

The same clearance as is required for workers, I.e. 24 in., except in low coal, where 18 in. may be approved.

How shall explosives be stored?

In cool, dry, well ventilated magazines.

With what material shall the outside of explosives magazines be constructed?

Incombustible material.

In what condition should the area in or around magazines be maintained?

Rubbish or accumulations of combustible material should not be permitted in or within 25 ft. of the magazines.

What methods of lighting shall not be permitted in magazines.

Open lights

What kind of lights may be used inside magazines?

Only permissible lights that are worn or carried.

Is it permissible to smoke, carry smokers' articles, or have open flames in or near any magazine?

No. Smoking, carrying smokers' articles, or having open flames is prohibited in or near any magazine.

What quantity of explosives may be stored underground in magazines?

Not more than a 48-hour supply.

How should explosives be stored near the working faces?

They shall be stored in separate, closed containers and shall be in a location that is at least 50 ft. from the face and out of the line of blasting.

How far from pipelines, power lines, rails, or conveyors shall explosives and detonators be kept when stored near the working faces?

At least 15 ft.

What distance shall separate explosives and detonators when stored near working faces?

A distance of at least 10 ft.

When shall explosives and detonators be removed from their containers?

Immediately before use at the working face.

What shall be posted near surface magazines?

Warning signs, placed so that a bullet passing directly through them will not hit the magazines.

What type of tools should be used to open cases of explosives?

Only non-metallic tools.

What safety precaution shall be taken with surface magazines?

They must be kept locked at all times when unattended.

What type of blasting units must be used to fire permissible explosives?

A permissible shot-firing unit of adequate capacity to fire all caps.

By whom shall shots be charged and fired?

By certified shotfirers designated by the mine foreman.

How is an electric blasting cap protected from stray electric current?

By means of a shunt.

How is a shunt made?

It is made by short-circuiting the ends of the leg wires.

How should a shunt on leg wires be maintained until its removal?

It should be short-circuited or shunted at the battery until ready to attach to the blasting unit.

What is the proper type of shot-firing cable?

A well insulated, two-conductor cable of adequate size, strength, and length to permit the shot firer to get to a safe place, i. e. around a corner of a pillar.

What precaution should be observed when unwinding the shot-firing cable?

The cable should be kept clear of power wires and all other possible sources of active or stray electric currents.

How should the shot firing cable be handled between the charge and the firing station?

It should be staggered as to length, ends kept well separated when attached to the detonator leg wires, and unreeled from the charge toward the “firing station”

What are the two dangers of electric firing?

The current may be applied before all workers have reached a safe place or stray electric currents may cause premature detonation.

When should the blasting cap be placed in explosives?

Not until the holes are ready to be charged.

Where should the blasting cap be placed when a bore hole is charged?

The blasting cap, or primer, shall be placed in the bore hole first, pointing outward, and the rest of the charge shall be pushed in a continuous train to the back of the bore hole to prevent cuttings from getting between the cartridges.

What is a primer?

An explosives cartridge with a blasting cap inserted.

How should the blasting cap be inserted in a primer?

In making a primer, a powder punch of non-sparking material shall be used. The hole in the cartridge shall be at least ½ in. deeper than the length of detonator used. Rolling the end of a cartridge is prohibited.

What is meant by the term “multiple blasting”?

Detonating more than one hole at a time.

What are the advantages of multiple blasting?

The shot firer is less likely to be injured by a premature blast caused by a possible misunderstanding and not as apt to be injured by roof loosened by preceding shots.

What are the disadvantages of multiple blasting?

One or more of the shots may fail to detonate due to faulty wiring or defective detonators. Failed shots are usually covered by loose coal from other shots and are undetected until dug into by machines or by hand.

How must the leg wires be connected when using delay detonators?

In a series circuit.

Why is series wiring of shots considered preferable?

If the shots are properly prepared and wired correctly, all shots will detonate, unless there is a defective detonator.

May instantaneous, regular or zero-delay detonators be fired in the same circuit as delay detonators?

No

What is the minimum delay interval between adjacent rows of shots when using delay detonators?

25 milliseconds.

What must be done before a misfire is removed when using delay detonators?

The failed shot must be tested with a galvanometer.

Does a shot firer and drill operator for solid blasting have to be certified?

Yes

Should mudcaps (adobes) or other non-permissible, unconfined shots be fired underground.

No

What is the purpose of cutting the coal prior to blasting?

To provide an additional free face or faces to assist the action of the explosive and lessen the danger of blown-out shots.

Must a coal mine have a permit to shoot from the solid?

Yes

What procedure should coal mine operators follow in order to engage in shooting coal from the solid?

They should submit an application for a permit to the Office of Mine Safety and Licensing.

What is the danger of blasting off the solid?

Ignition of explosive mixtures of gas and coal dust by blown-out shots.

What is the minimum burden that all blasting charges shall have?

Eighteen inches in all directions, if the height of the seam permits.

What is the limit of drilling blast holes in relation to cut depth?

Blast holes shall not be drilled beyond the depth of the cut.

What is the remedy for holes that are drilled deeper than the cut?

The holes must be stemmed with incombustible material to the depth of the cut.

Why should holes not be drilled deeper than the depth of the machine cut?

They may result in a blown-out shot and will not be as effective.

How does the shot-firer know if holes are drilled to the correct depth?

By carefully measuring the depths of the cut and holes.

How shall a hole be prepared before loading the charge?

It shall be scraped as clean as possible.

What may be the result of a charge that is separated by unremoved drill cuttings?

Incomplete explosion and possible burning of the unexploded charge.

How many types or brands of explosives may be used in the same hole?

Only one.

How shall explosives be placed in the borehole?

Explosives shall be pushed into the hole in a continuous train, with no cushions between the back of the hole and the explosives or between the explosives and the stemming.

How shall explosives be confined in a drill hole?

They shall be confined with incombustible stemming material.

What is proper stemming material?

Incombustible material such as sand, clay, rock dust, or special devices such as water dummies.

Why is coal dust stemming dangerous?

The flame of the explosive blast will be increased and the coal dust may be ignited.

What are the practical benefits of proper stemming?

Proper stemming makes a shot more effective.

What is the danger of improper stemming?

The danger of a blown-out shot.

What type of tool should be used for tamping?

Only non-metallic tamping bars shall be used for charging and tamping bore holes. This does not prohibit the use of a non-metallic tamping bar with a non-sparking metallic scraper on one end.

What kind of tamping tools are prohibited?

Metal or metal-clad tamping bars.

After holes have been charged, what should be done with surplus explosives?

They should be removed from the place to be blasted and out of the line of fire.

Can flying coal or slate from a shot detonate permissible explosives?

Yes. Miners have been killed when explosives were not removed to a safe place and were detonated by flying material from shots.

May electrical equipment be operated in the face area while blast holes are being charged?

No

How soon after charging shall holes be fired?

Promptly

What may be the cause of premature detonation of a shot?

Stray electric currents.

What creates the force when an explosive is fired?

The sudden expansion of the gases liberated.

What is required before shots may be fired in a working place?

The place shall be properly examined for the presence of methane.

What is considered a dangerous percentage of methane when permissible explosives are to be fired?

A methane content of 1% or more.

In what direction is the maximum force of an explosive exerted?

The force is exerted equally in all directions; however, it takes the direction of least resistance.

How should warnings be given when shots are about to be fired?

By distinctly shouting “fire” three times after miners have withdawn from the area where the blasting will occur.

What should persons do when warned that shots are to be fired?

They should withdraw immediately and proceed to a safe place.

Where should persons be when shots are fired?

Around the corner of a pillar and out of the line of fire.

When should the shot firer make the connection to the shooting cable?

When all persons are out of the line of fire.

How soon may a person approach the face after a shot has been fired?

Not until the smoke has cleared away.

What shall be done before work is resumed after blasting?

The roof shall be examined and the working place shall be checked for gases and made safe.

What is the first thing to do when a misfire has occurred?

Disconnect the wires from the blasting unit and short-circuit them at that location.

How long shall any person wait after a misfire before going back into the place?

At least five minutes.

How shall a misfire be removed?

By firing a separate charge at least two feet away from, and parallel to, the misfired charge or by washing the stemming and the charge from the bore hole with water, or by inserting and firing a new primer after the stemming has been washed out.

Who shall supervise the removal of a misfire?

A foreman or a competent person.

What method of removing misfires is not permitted?

Drilling them out.

How can misfires be prevented?

By careful selection of the explosives and firing devices and correct loading and firing of the charge.

What precaution should be taken with respect to misfires when using multiple blasting?

A careful examination should be made for misfires after each shot.

Who shall be designated to fire shots?

Only a certified shot firer.

What is the danger of adobe or mud-capping with explosives other than permissible sheathed explosives?

The unconfined explosion will raise coal dust which may become ignited.

What important regulation must be followed in the use of explosives and detonators underground?

Except for work involved in sinking a shaft or slope from the surface, all explosives and blasting devices used underground must be of the permissible type, including explosives used for blasting rock.

When may explosives and detonators be removed from their original containers?

Not until all other preparation work is completed and boreholes are ready for charging.

What type of blasting units may be used while firing underground?

Only permissible blasting units, unless firing is done from the surface with all personnel out of the mine.

What precaution must be taken when using permissible explosives in a mine?

A test for gas shall be made before and after firing each shot or group of shots.

What other work may be done while shots are being charged?

No other work shall be permitted in the danger zone except emergency work necessary to safeguard the employees.

What type of tools may be used for opening explosive cases or boxes and inserting holes in the individual sticks of explosives?

Only non-sparking tools may be used for this type of work.

When may the shunt be removed from the detonator leg-wire?

Not until the shot-firer is ready to connect to the firing cable.

May shots be fired by any other means than a permissible unit?

No, except when all personnel are outside the mine.

What safety measure must be strictly observed before shots are fired in any working place?

Ample warning must be given and care taken to ascertain that all persons are in the clear, including persons working in the adjoining vicinity, before shots are fired.

What is the danger of under-charging or over-charging a shot or shots?

Blown-out shots.

How many holes may be fired at the same time and remain permissible?

No more holes may be fired at any one time than the number for which the permissible shot-firing unit is designed.

What device should be used to check the continuity of a circuit before blasting?

A galvanometer.

End of Unit 4