MSHA Training
Explosives & Blasting Safety

Training Objective

Review and understand……

Safety is critical when working with explosives.
Explosive classes and categories.
Blasting Theory.
The Blast Area.
Always & Never.
Poor Practice & Best Practice
Blast Site Safety
Sources of Flyrock.
Blasting Mats

MSHA Training
Explosives & Blasting Safety

All explosives are made to do one thing!

Safety is critical when working with explosives, whether we are handling, storing, using, or transporting explosive products we must use safe practices.

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Nothing can be left to chance

Highway Blast 2018 706-06-00922_BLAST_VIDEO.MP4

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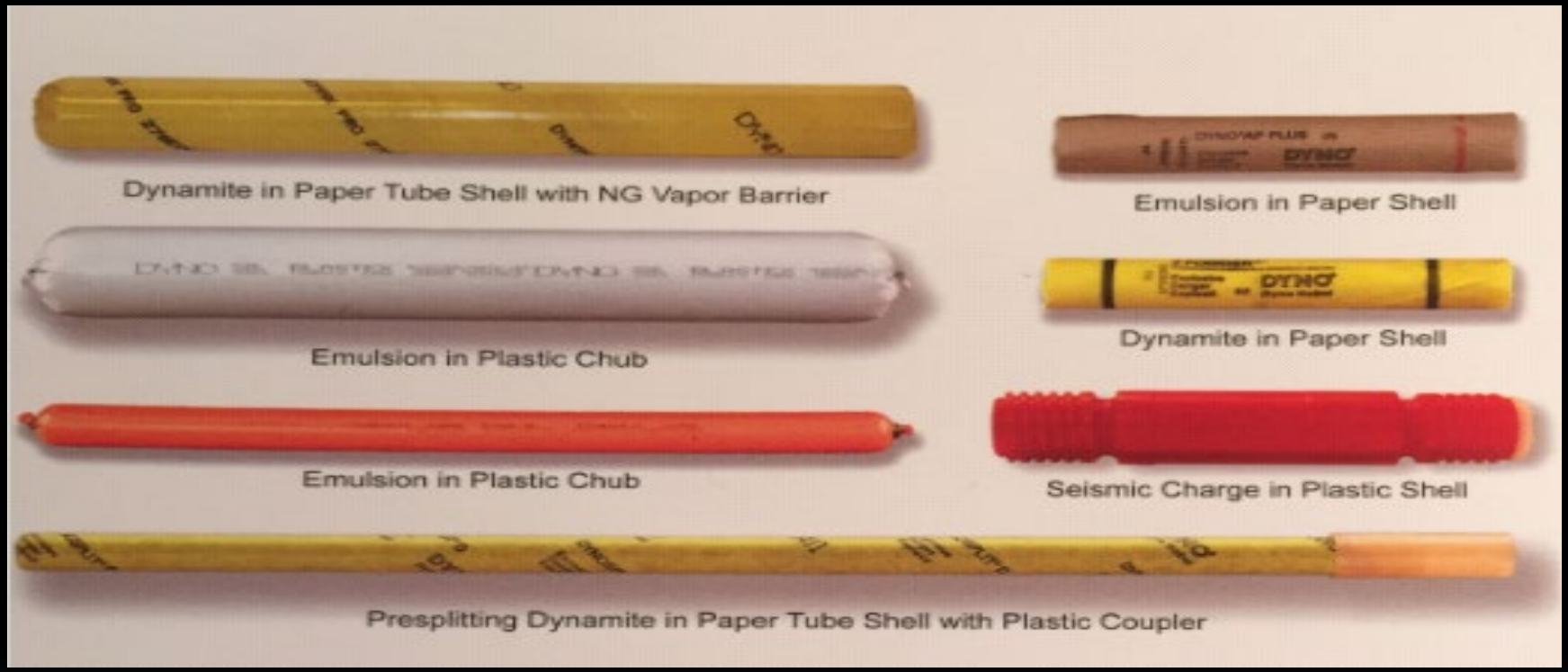

Packaged Explosives:

Dynamite
Emulsion
Anfo
Seismic

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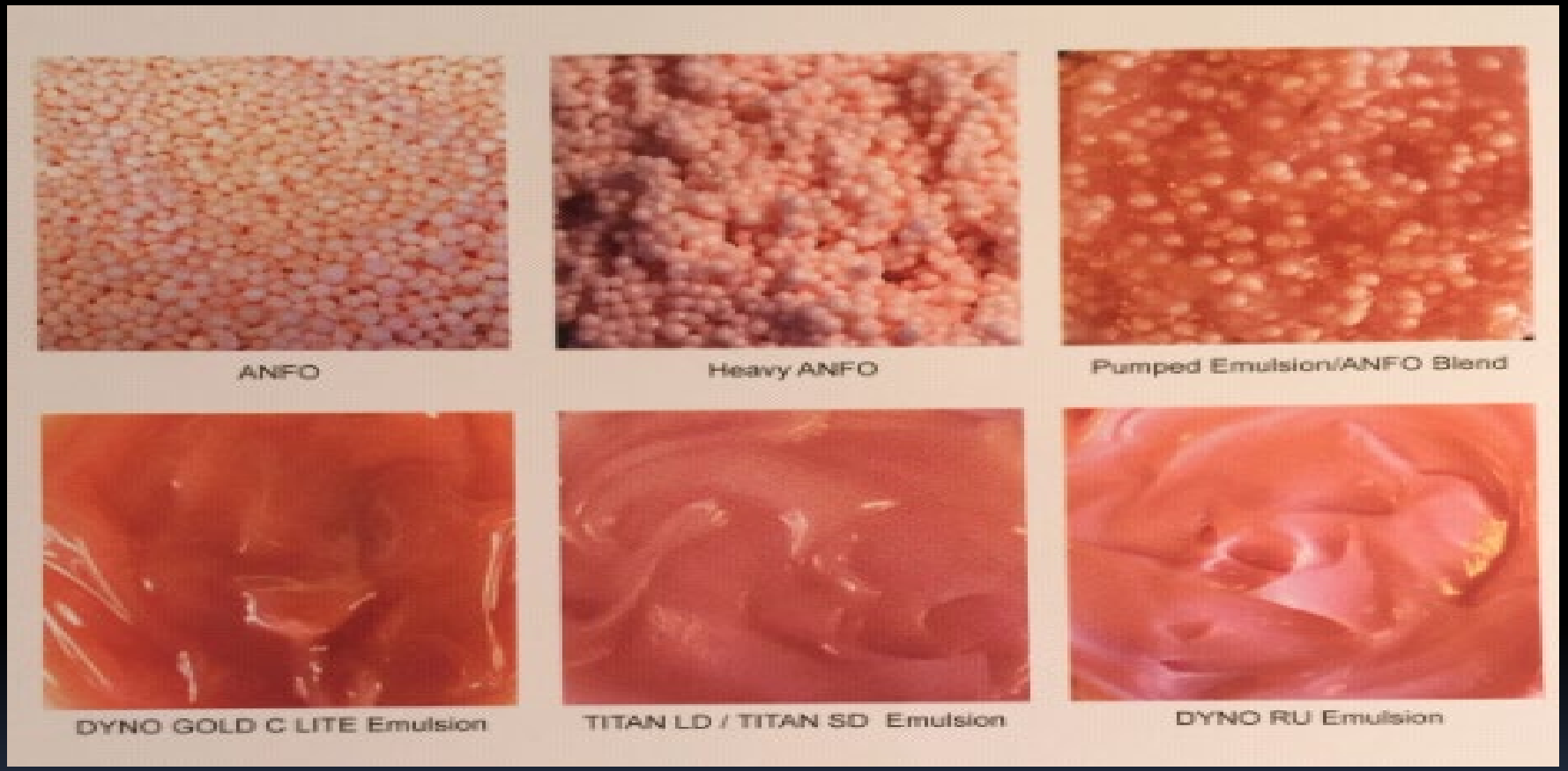

Bulk Explosives

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Cast Boosters & Detonating Cord

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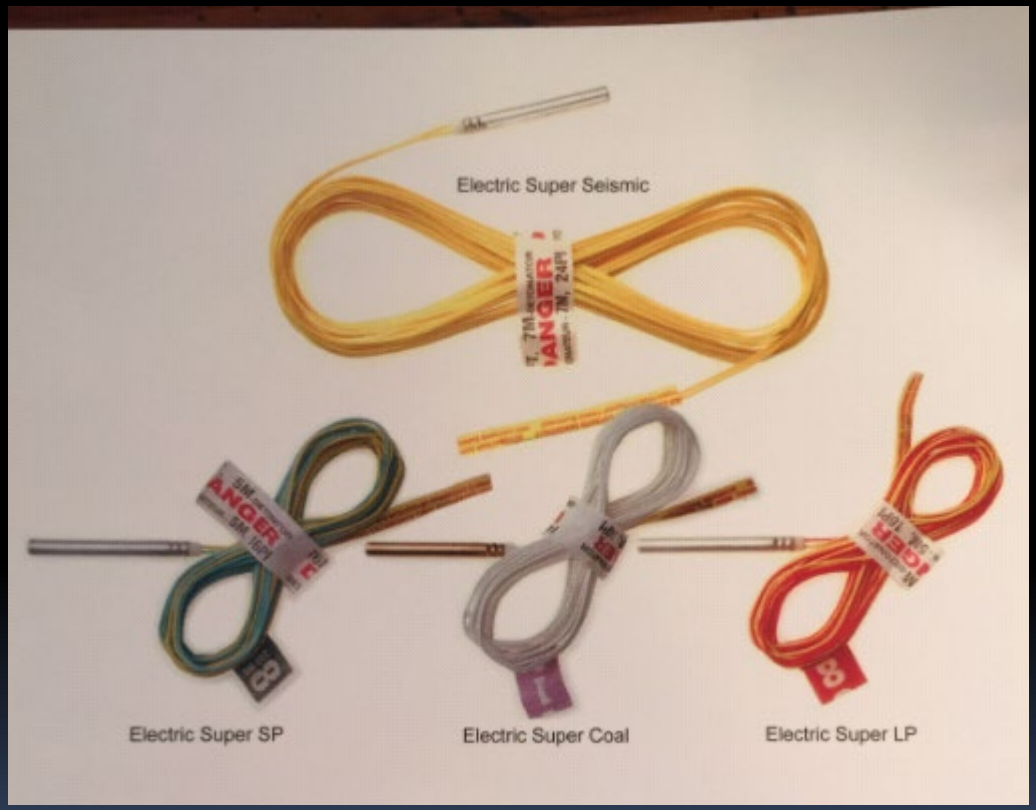

Electric Initiation

- **Electric Instant**
- **Electric Super/Seismic**
- **Electric Super Coal**

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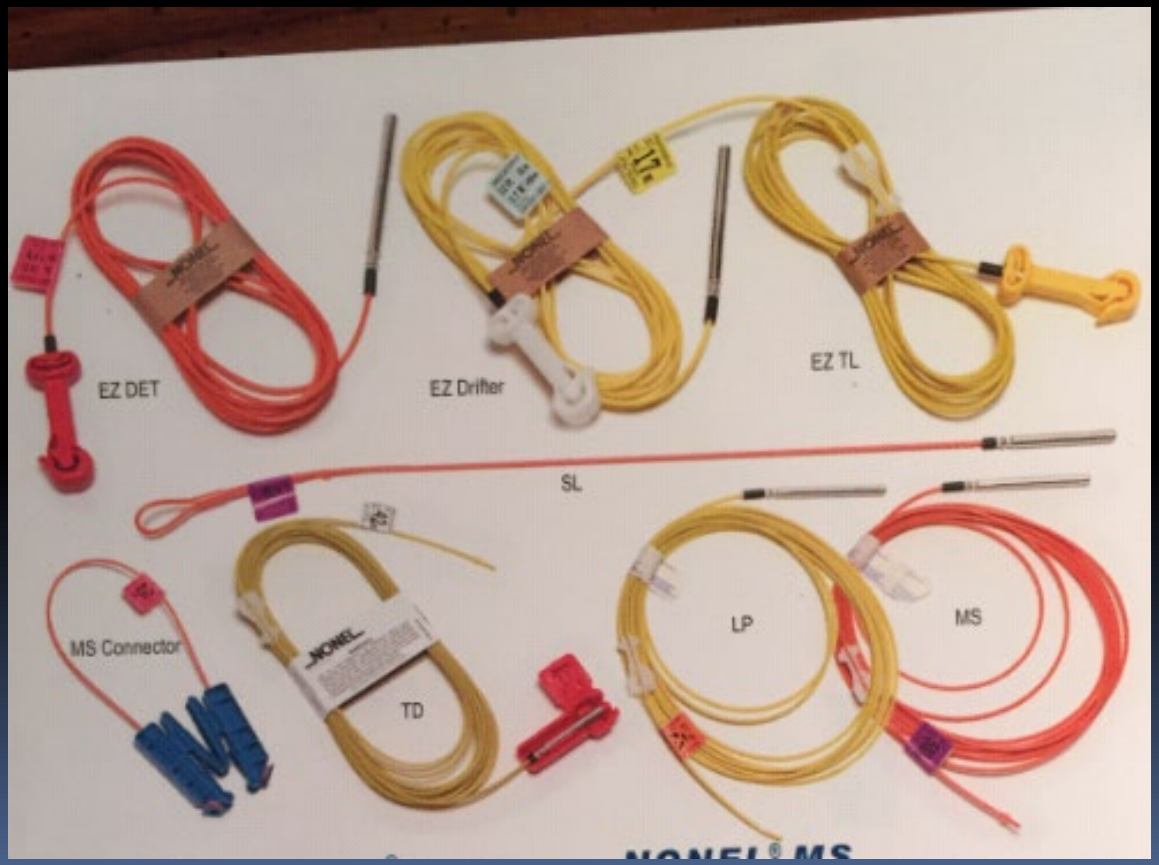
NONEL Nonelectric Initiation
- Nonel EZDET
- Nonel EZTL
- Nonel MS
- Nonel LP
- Nonel SL
- Nonel MS Connector



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Explosives & Blasting Safety

Explosive & Blasting Theory

Energy follows the path of least resistances.

It needs a place to go. And, it is our job to ensure we control the energy and give the energy the safest path.

Energy Distribution – energy must be evenly distributed to achieve uniform fragmentation. (Good blast pattern)

Energy Confinement – energy must be confined long enough after detonation to establish fractures and displace the material. (Appropriate timing)

Energy Level – energy must be sufficient to overcome structural strength and mass of rock. (Powder Factor)

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Explosive categories……..3 general categories

High Explosives – blasting agents; dynamite, unimax, cast boosters.

Detonators – ezdets; eztl; electric and electronics

Blasting Agents – blastex, blast gel, bulk emulsions, titan products blends

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Explosives & Blasting Safety

The Blast Area

The **Blast Site** – the area established by the blaster where **blast holes are being loaded, or in the process of being loaded.**

The **Blast Area** – the area around the blast site where **material is expected to travel** or be displaced into during the blast event.

The **Safety Buffer** – the area designated between the blast area and the safety zone wher **material is not expected to travel**. If BIC must be within the safety buffer when shot is initiated the BIC should use a blasting shelter.

The **Safety Zone** – the **area where minimum threat of injury or damage is present**.

The Safety Zone is considered a safe location/distance to initiate the shot.

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Explosives & Blasting Safety

A Blaster In Charge will be designated for each blast.

All unsafe conditions shall be reported to and addressed by the BIC.

BIC's are required to review the JHA and Site Security Plan with entire crew.

BIC's are required to hold safety meetings for each blast.

Product shall not be pre-primed.

Non-sparking tools required.

Never tamp blocked explosives of any type.

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Explosives & Blasting Safety

Blast Site Inspections & Site Security

All access routes to the blast area shall be guarded or barricaded to prevent the passage of persons or vehicles.

Work shall not be resumed in the blast safety zone until the Blaster Supervisor has conducted a post blast examination addressing potential blast related hazards with the ability and experience to perform the examination.

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Explosives & Blasting Safety

MSHA 30 CFR Part 57 57.6306 Loading, Blasting, and security

The post blast inspection should be performed by the Blaster Supervisor only after it is safe to do so.

No other activities should resume in the area Until the Blaster Supervisors gives the "ALL CLEAR" Signal.

Any hazards identified during the post blast inspection should be immediately communicated to the appropriate personnel and misfire remediation should be implemented.
Or isolate the hazard.

The Blaster Supervisor Is required, in many cases, to inform the mine management but must always inform his/her Immediate supervisor.

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Explosives & Blasting Safety

ALWAYS & NEVER

Always keep matches, lighters, open flame and other sources of ignition at least 50 feet away from parked vehicles carrying explosive material

ALWAYS & NEVER

Always load and unload explosive material carefully.

ALWAYS & NEVER

Never handling explosive material during or during the approach of an electrical storm.

ALWAYS & NEVER

Never leave a vehicle containing explosive material unattended.

ALWAYS & NEVER

Never fight fires involving explosive material. Remove yourself and others from the area.

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Explosives & Blasting Safety

ALWAYS & NEVER

Never put explosive material in your pockets.

ALWAYS & NEVER

Always close partially used packages of Explosive material.

ALWAYS & NEVER

Always store explosives in their original package.

ALWAYS & NEVER

Never investigate the contents of a detonator.

MSHA Training
Explosives & Blasting Safety

ALWAYS & NEVER

Never subject explosive material to Excessive impact or friction.

ALWAYS & NEVER

Always inspect highwall & crest conditions.

ALWAYS & NEVER

Always check the borehole to assure it is safe for loading.

ALWAYS & NEVER

Never place any parts of the body in front of the borehole except those required for loading.

MSHA Training
Explosives & Blasting Safety

ALWAYS & NEVER

Never force or attempt to force a detonator Into explosive material.

ALWAYS & NEVER

Always post guards to prevent access to the blast pattern.

ALWAYS & NEVER

Always sound adequate warnings prior to blast.

ALWAYS & NEVER

Never breathe the dust or vapors from explosive material.

ALWAYS & NEVER

Always fire the shot from outside the blast area and use an adequate blast Shelter that provides protection from flying material.

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Explosives & Blasting Safety

Poor Practice: the booster and detonator are sinking into the stemming, loss product. The lines have the potential to become nicked or cut.

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Explosives & Blasting Safety

Poor Practice: product is not separated at the borehole. Place Detonators and boosters on opposite sides of the borehole.

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Poor Practice – the green line and blast sign serve as warning signs that there is a hazard. We need to have a clear vision to the warnings signs.

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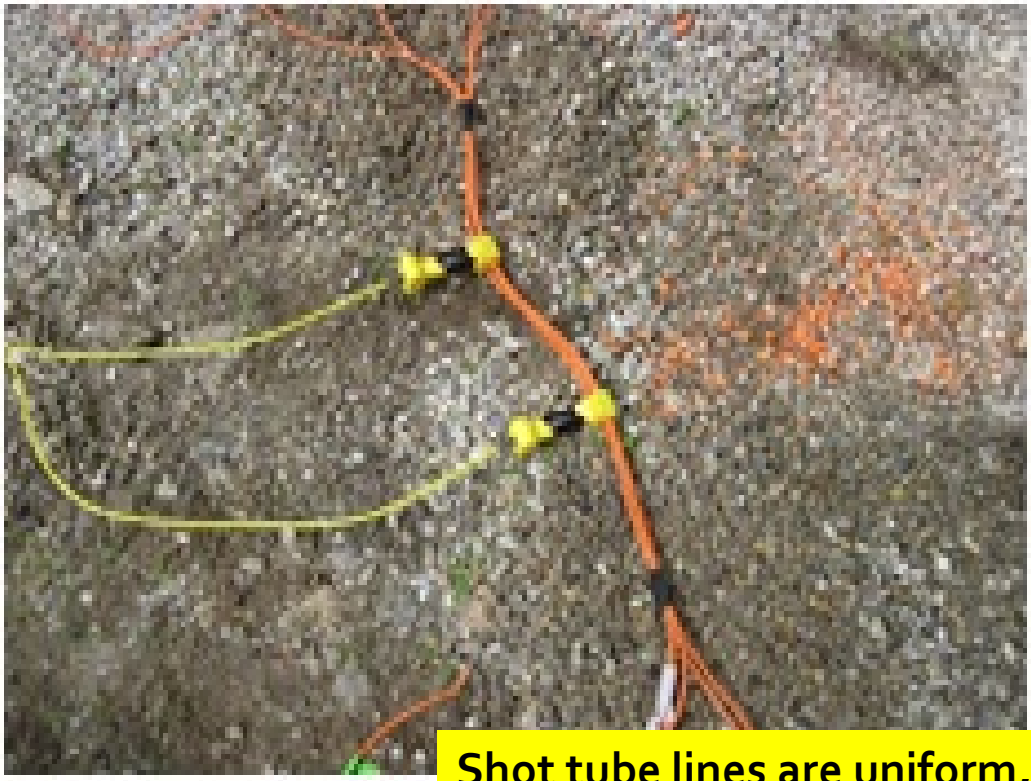
Explosives & Blasting Safety

Poor Practice: a loaded borehole is being used as an anchor for fall prevention.

MSHA Training
Explosives & Blasting Safety

Poor Practice: wires look like tangled XMAS Lights

MSHA Training
Explosives & Blasting Safety



Shot tube lines are uniform, untangled and taped. Tubes and wires neat, and wires taped Detonators facing the same direction away from the unfired row in front. Blast site clear of slip/trip & fall hazards: loose rock, casings, hole plugs, empty cartons, maintain 100 ft. when smoking,.

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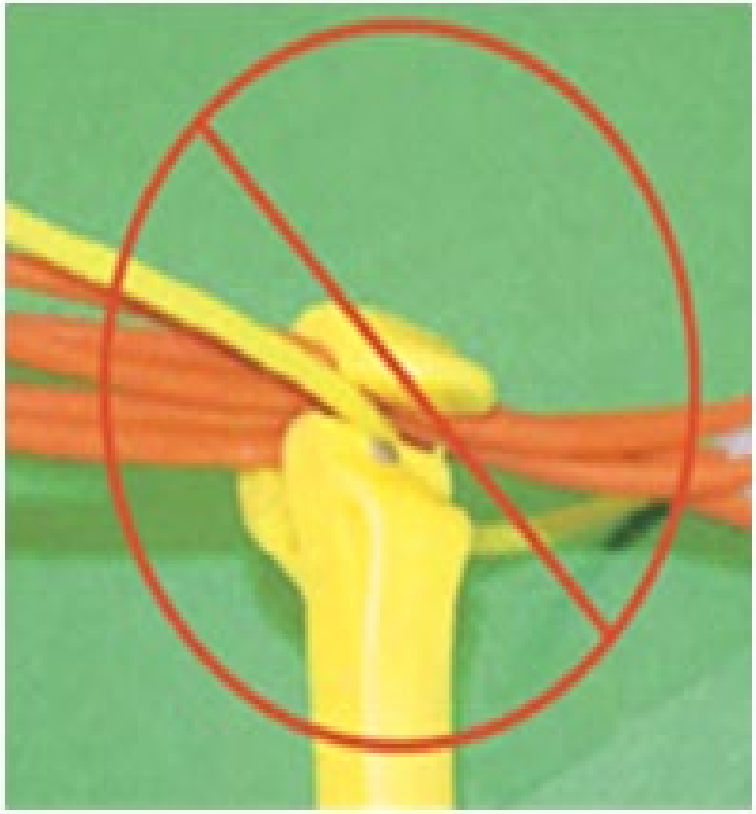
Explosives & Blasting Safety

Shock tube leads incorrectly seated. Yellow lead is crossed over, potential for a misfire.



X

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Explosives & Blasting Safety

The shock tube line is fully inserted in the EZ Connector Block.

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What is the hazard?

Trip Hazard, run over hose, wear & tear on hose.

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What is the hazard? Fall prevention , too much rope. Housekeeping, product thrown, Water, standing on cap.

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Best Practice

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MSHA Training
Explosives & Blasting Safety

Subchapter K Part 56
Safety & Health Standards
Surface Mines Metal/Nonmetal

56.1 Purpose and scope.

This part 56 sets forth mandatory safety and health standards for each surface metal or nonmetal mine, including open pit mines, subject to the Federal Mine Safety and Health Act of 1977. The purpose of these standards is the protection of life, the promotion of health and safety, and the prevention of accidents.

MSHA Training
Explosives & Blasting Safety

Subchapter K Part 56
Safety & Health Standards
Surface Mines Metal/Nonmetal

56.3130 Wall, bank, and slope stability

Mining methods shall be used that will **maintain wall, bank, and slope stability** in places where persons work or travel in performing their assigned tasks.

When benching is necessary, the width and height shall be based on the type of equipment used for cleaning of benches or for scaling of walls, banks, and slopes.

MSHA Training
Explosives & Blasting Safety

Subchapter K Part 56
Safety & Health Standards
Surface Mines Metal/Nonmetal

56.3131 Pit or quarry wall perimeter

In places where persons work or travel in performing their assigned tasks, loose or unconsolidated material shall be sloped to the angle of repose or stripped back for at least 10 feet from the top of the pit or quarry wall.

Other conditions at or near the perimeter of the pit or quarry wall which create a fall-of-material hazard to persons shall be corrected.

MSHA Training
Explosives & Blasting Safety

Subchapter K Part 56
Safety & Health Standards
Surface Mines Metal/Nonmetal

56.3200 Correction of hazardous conditions

Ground conditions that create a hazard to persons shall be taken down or supported before other work or travel is permitted in the affected area.

Until corrective work is completed, the area shall be posted with a warning against entry and, when left unattended, a barrier shall be installed to impede unauthorized entry.

MSHA Training
Explosives & Blasting Safety

Subchapter K Part 56
Safety & Health Standards
Surface Mines Metal/Nonmetal

56.3401 Examination of ground conditions

Persons experienced in examining and testing for loose ground shall be designated by the mine operator.

Appropriate supervisors or other designated persons shall examine and, where applicable, test ground conditions in areas where work is to be performed prior to work commencing, after blasting, and as ground conditions warrant during the work shift.

High walls and banks adjoining travel ways shall be examined weekly or more often if changing ground conditions warrant.

MSHA Training
Explosives & Blasting Safety

Subchapter K Part 56
Safety & Health Standards
Surface Mines Metal/Nonmetal

56.3430 Activity between machinery or equipment and the highwall or bank

Persons shall not work or travel between machinery or equipment and the highwall or bank where the machinery or equipment may hinder escape from falls or slides of the highwall or bank.

Travel is permitted when necessary for persons to dismount.

MSHA Training
Explosives & Blasting Safety

Subchapter K Part 56
Safety & Health Standards
Surface Mines Metal/Nonmetal

56.6300 Control of blasting operations

(a) Only persons trained and experienced in the handling and use of explosive material shall direct blasting operations and related activities.

(b) Trainees and inexperienced persons shall work only in the immediate presence of persons trained and experienced in the handling and use of explosive material.

MSHA Training
Explosives & Blasting Safety

Subchapter K Part 56
Safety & Health Standards
Surface Mines Metal/Nonmetal

56.6301 Blast hole obstruction check

Before loading, blast holes shall be checked and, wherever possible, cleared of obstructions.

56.6302 Separation of explosive material

Explosives and blasting agents shall be kept separated from detonators until loading begins.

MSHA Training
Explosives & Blasting Safety

Subchapter K Part 56
Safety & Health Standards
Surface Mines Metal/Nonmetal

56.6303 Initiation preparation

(a) Primers shall be made up only at the time of use and as close to the blast site as conditions allow.

(b) Primers shall be prepared with the detonator contained securely and completely within the explosive or contained securely and appropriately for its design in the tunnel or cap well.

(c) When using detonating cord to initiate another explosive, a connection shall be prepared with the detonating cord threaded through, attached securely to, or otherwise in contact with the explosive.

MSHA Training
Explosives & Blasting Safety

Subchapter K Part 56
Safety & Health Standards
Surface Mines Metal/Nonmetal

56.6311 Handling of misfires

(a) Faces and muck piles shall be examined for misfires after each blasting operation.

(b) Only work necessary to remove a misfire and protect the safety of miners engaged in the removal shall be permitted in the affected area until the misfire is disposed of in a safe manner.

(c) When a misfire cannot be disposed of safely, each approach to the area affected by the misfire shall be posted with a warning sign at a conspicuous location to prohibit entry, and the condition shall be reported immediately to mine management.

(d) Misfires occurring during the shift shall be reported to mine management not later than the end of the shift.

MSHA Training
Explosives & Blasting Safety

Subchapter K Part 57
Safety & Health Standards
Underground Mines Metal/Nonmetal

57.1 Purpose and scope

This part 57 sets forth mandatory safety and health standards for each underground metal or nonmetal mine, including related surface operations, subject to the Federal Mine Safety and Health Act of 1977. The purpose of these standards is the protection of life, the promotion of health and safety, and the prevention of accidents.

MSHA Training
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Surface Stone vs Underground

Three notable differences

- Transportation
- Ground control
- Communication

WHY?

MSHA Training
Explosives & Blasting Safety

The most common cause of underground blasting incident(s) is improper blast area security.

Have a Site Security Plan in Place.

Workplace & Face Inspection

- The Miner must always examine each heading for loose ground or any unsafe condition before entering the work area.
- Loose ground must be scaled and bolted before starting work.
- The face must be inspected and bootlegs must be examined for undetonated explosives.
- Any explosives found in bootlegs must be flushed out, removed or detonated before starting work.

MSHA Training
Explosives & Blasting Safety

Scaling Practices

Poor scaling practices result in:

- Increased risk to personnel by rock falls, slips & strains.
- An increase in charge up time.
- Increased costs in maintenance due to damage of jumbo.
- Drill quality compromised.
- Increased time in the D&B cycle.
- Production targets compromised.

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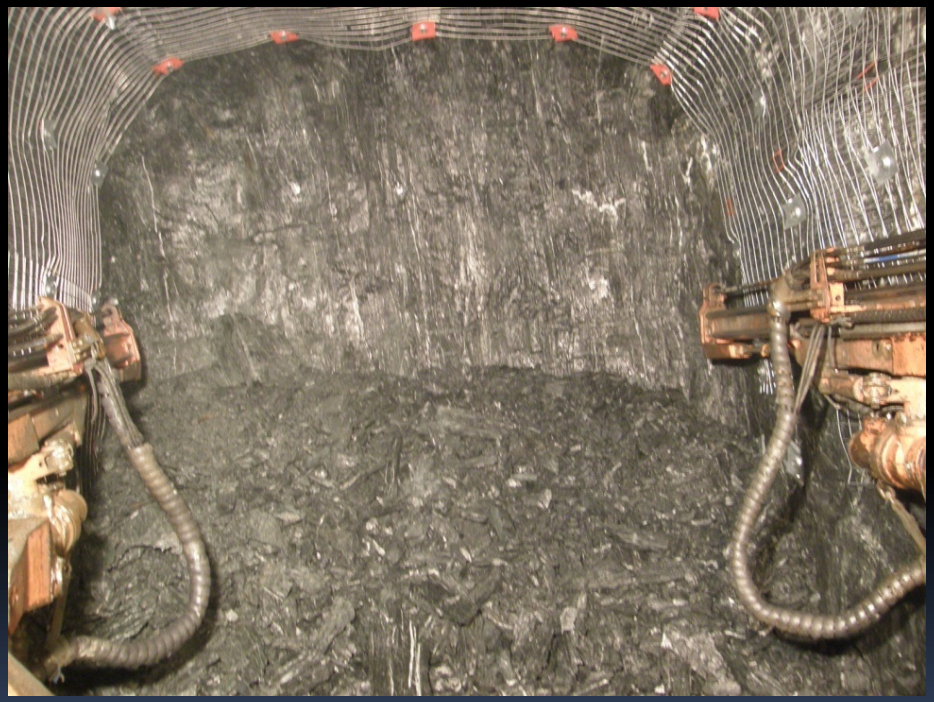
Explosives & Blasting Safety

- Good scaling practices



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Poor scaling practices

MSHA Training
Explosives & Blasting Safety
Roof Control/Roof Falls

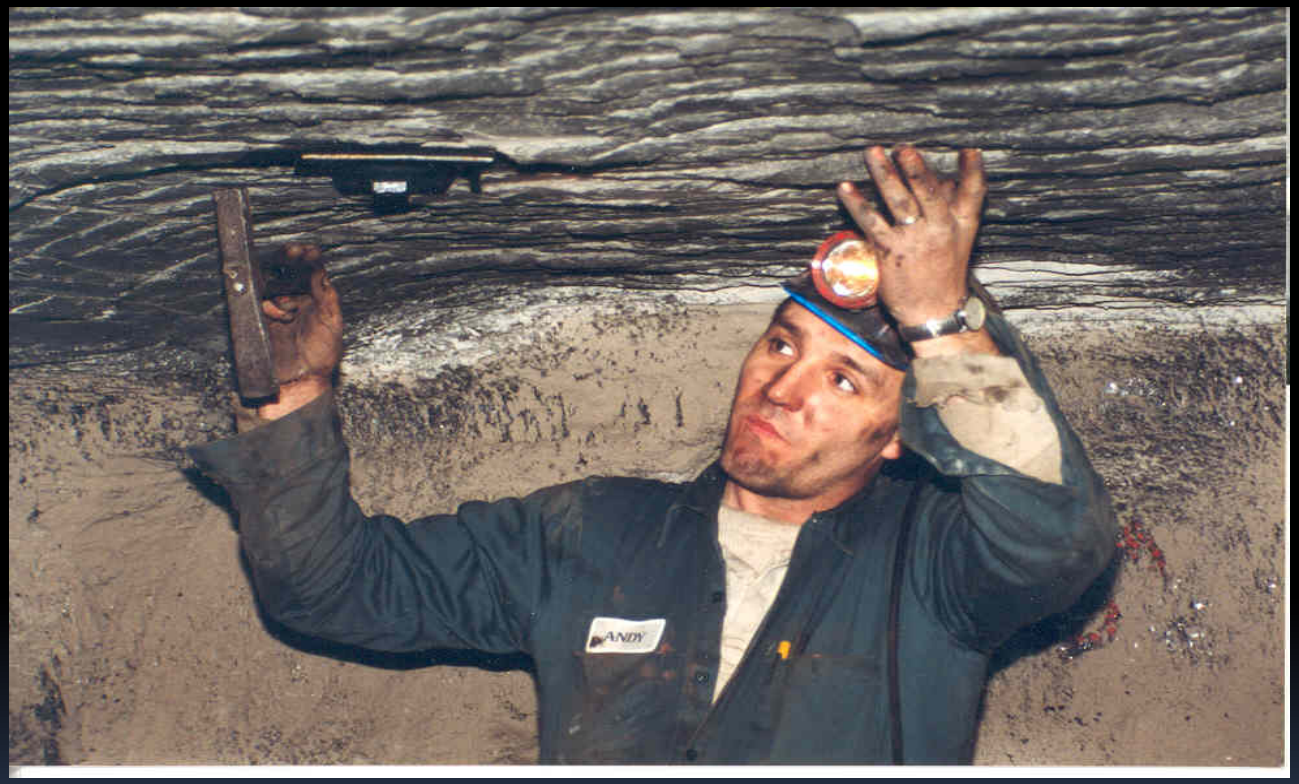
Roof and rib conditions vary from mine to mine and in some instances from section to section within the mine.

The type of sedimentary rock such as shale, sandstone, and limestone, overlying the coal seams dictates the strength of the mine roof.

Combine this variable roof rock with other geological features such as faults and joints you can see why roof control is challenging.

What works to control the roof and rib conditions in one mine may not work in another.

MSHA Training
Explosives & Blasting Safety
Roof Control/Roof Falls



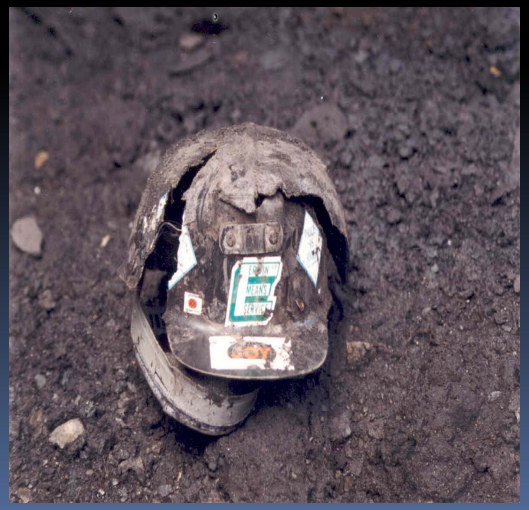
Roof must be inspected periodically to ensure safety.

MSHA Training
Explosives & Blasting Safety
Roof Control/Roof Falls

Miners need to be constantly aware of the potential dangers posed by movement of the roof & rib.

During the last few years, several miners have died in roof falls in intersections.

The underground coal miner wearing this hard hat received fatal injuries in a roof fall accident.



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Explosives & Blasting Safety
Roof Control/Roof Falls

Consider the roof unsupported until supports are installed to help stabilize and secure the rock.

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Explosives & Blasting Safety
Roof Control/Roof Falls
Roof Supports

First category :
Roof bolts installed within the mine roof.

Anchorage tensioned roof bolt - a steel or metal rod installed into a hole drilled into the mine roof that applies tension between the mine roof and a point of anchorage in the mine roof.

MSHA Training
Explosives & Blasting Safety

Roof Control/Roof Falls

- Rib conditions found to be unsafe are required to be taken down or securely supported.
- Notify the mine foreman immediately if unsafe roof or rib conditions are observed.

Pillar rib failure in a limestone mine

MSHA Training
Explosives & Blasting Safety
Air & Mine Gasses

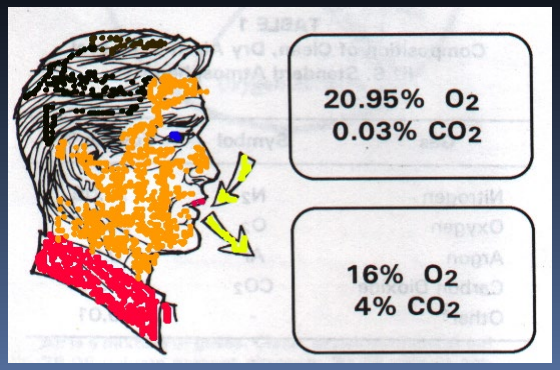
The air we breath is a mixture of gases and is necessary for life.

Air is also used in mining to remove unwanted gases and dust.

As air passes through a mine, it picks up unwanted gases and dust form by mining.

At the same time, the oxygen in the air is consumed by the people and surroundings of the mine.

MSHA has legal requirements for Oxygen; air must contain at least 19.5% oxygen.



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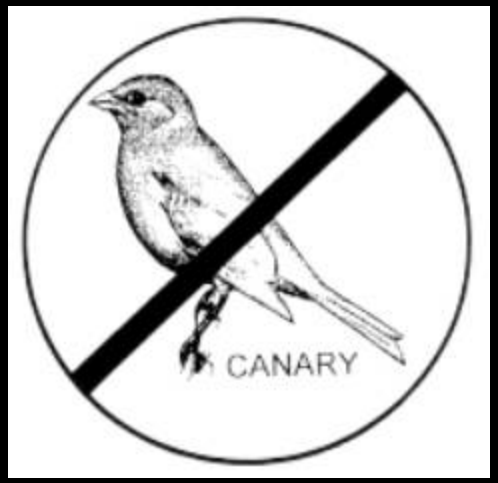
Explosives & Blasting Safety
Air & Mine Gasses

Oxygen levels and effects on the body

21 %	Normal Breathing
19.5 %	Minimum required by law
17 %	Breathing faster &deeper
15 %	Dizziness, buzzing noise, rapid pulse, headache, blurred vision
9 %	Unconsciousness
6 %	Breathing stops, cardiac arrest

MSHA Training
Explosives & Blasting Safety
Gas Detection

The most reliable way to evaluate the mine atmosphere is to use detectors approved by MSHA.



Methane and low oxygen can be very hazardous underground.

MSHA Training
Explosives & Blasting Safety
Underground Hazards Include

Underground high voltage transformers and cables.

MSHA Training
Explosives & Blasting Safety
Underground Hazards Include

Areas of Operating Equipment

Always inform equipment operators of your presence when near equipment in operation.

Most common systems for mine hauling:

1. shuttle cars
2. continuous haulage systems (conveyor)
3. battery scoops

MSHA Training
Explosives & Blasting Safety
Underground Hazards Include

Snakes and spiders will hide in underground areas.

MSHA Training
Explosives & Blasting Safety
Underground Hazards Include

Water can be hazardous when underground.

MSHA Training
Explosives & Blasting Safety

Subchapter K Part 57
Safety & Health Standards
Underground Mines Metal/Nonmetal

57.3200 Correction of hazardous conditions

Ground conditions that create a hazard to persons shall be taken down or supported before other work or travel is permitted in the affected area. Until corrective work is completed, the area shall be posted with a warning against entry and, when left unattended, a barrier shall be installed to impede unauthorized entry.

MSHA Training
Explosives & Blasting Safety

Subchapter K Part 57
Safety & Health Standards
Underground Mines Metal/Nonmetal

57.3201 Location for performing scaling

Scaling shall be performed from a location which will not expose persons to injury from falling material, or other protection from falling material shall be provided.

MSHA Training
Explosives & Blasting Safety

Subchapter K Part 57
Safety & Health Standards
Underground Mines Metal/Nonmetal

57.3401 Examination of ground conditions

Persons experienced in examining and testing for loose ground shall be designated by the mine operator. Appropriate supervisors or other designated persons shall examine and, where applicable, test ground conditions in areas where work is to be performed, prior to work commencing, after blasting, and as ground conditions warrant during the work shift.

Underground haulageways and travelways and surface area highwalls and banks adjoining travelways shall be examined weekly or more often if changing ground conditions warrant.

MSHA Training
Explosives & Blasting Safety

Subchapter K Part 57
Safety & Health Standards
Underground Mines Metal/Nonmetal

57.3460 Maintenance between machinery or equipment and ribs

Persons shall not perform maintenance work between machinery or equipment and ribs unless the area has been tested and, when necessary, secured.

MSHA Training
Explosives & Blasting Safety

Subchapter K Part 57
Safety & Health Standards
Underground Mines Metal/Nonmetal

57.6300 Control of blasting operations

(a) Only persons trained and experienced in the handling and use of explosive material shall direct blasting operations and related activities.

(b) Trainees and inexperienced persons shall work only in the immediate presence of persons trained and experienced in the handling and use of explosive material.

MSHA Training
Explosives & Blasting Safety

Subchapter K Part 57
Safety & Health Standards
Underground Mines Metal/Nonmetal

57.6900 Damaged or deteriorated explosive material.
Damaged or deteriorated explosive material shall be disposed of in a safe manner in accordance with the instructions of the manufacturer.

57.6905 Protection of explosive material.
(a) Explosive material shall be protected from temperatures in excess of 150 degrees Fahrenheit.
(b) Explosive material shall be protected from impact, except for tamping and dropping during loading.

MSHA Training
Explosives & Blasting Safety

Subchapter K Part 57
Safety & Health Standards
Underground Mines Metal/Nonmetal

57.6301 Blasthole obstruction check

Before loading, blastholes shall be checked and, wherever possible, cleared of obstructions.

57.6304 Primer protection

(a) Tamping shall not be done directly on a primer.

MSHA Training
Explosives & Blasting Safety

Subchapter K Part 57
Safety & Health Standards
Underground Mines Metal/Nonmetal

57.6310 Misfire waiting period

When a misfire is suspected, persons shall not enter the blast area—
(a) For 30 minutes if safety fuse and blasting caps are used; or
(b) For 15 minutes if any other type detonators are used.

MSHA Training
Explosives & Blasting Safety

Subchapter K Part 57
Safety & Health Standards
Underground Mines Metal/Nonmetal

57.6311 Handling of misfires

(a) Faces and muck piles shall be examined for misfires after each blasting operation.

(b) Only work necessary to remove a misfire and protect the safety of miners engaged in the removal shall be permitted in the affected area until the misfire is disposed of in a safe manner.

(c) When a misfire cannot be disposed of safely, each approach to the area affected by the misfire shall be posted with a warning sign at a conspicuous location to prohibit entry, and the condition shall be reported immediately to mine management.

(d) Misfires occurring during the shift shall be reported to mine management not later than the end of the shift.

MSHA Training
Explosives & Blasting Safety

Subpart A Part 77
Surface Coal Mines & Surface Work Areas
Of Underground Coal Mine

77.1 Scope

This part 77 sets forth mandatory safety standards for bituminous, anthracite, and lignite surface coal mines, including open pit and auger mines, and to the surface work areas of underground coal mines, pursuant to section 101(i) of the Federal Mine Safety and Health Act of 1977.

MSHA Training
Explosives & Blasting Safety

Subpart A Part 77
Surface Coal Mines & Surface Work Areas
Of Underground Coal Mine

77.1713 Daily inspection of surface coal mine; certified person; reports of inspection

(a) At least once during each working shift, or more often if necessary for safety, each active working area and each active surface installation shall be examined by a certified person designated by the operator to conduct such examinations for hazardous conditions and any hazardous conditions noted during such examinations shall be reported to the operator and shall be corrected by the operator.

(b) If any hazardous condition noted during an examination conducted in accordance with paragraph (a) of this section creates an imminent danger, the person conducting such examination shall notify the operator and the operator shall withdraw all persons from the area affected, except those persons referred to in section 104(d) of the Act, until the danger is abated.

MSHA Training
Explosives & Blasting Safety

Subpart A Part 77
Surface Coal Mines & Surface Work Areas
Of Underground Coal Mine

(c) After each examination conducted in accordance with the provisions of paragraph (a) of this section, each certified person who conducted all or any part of the examination required shall enter with ink or indelible pencil in a book approved by the Secretary the date and a report of the condition of the mine or any area of the mine which he has inspected together with a report of the nature and location of any hazardous condition found to be present at the mine. The book in which such entries are made shall be kept in an area at the mine designated by the operator to minimize the danger of destruction by fire or other hazard.

MSHA Training
Explosives & Blasting Safety

Subpart A Part 77
Surface Coal Mines & Surface Work Areas
Of Underground Coal Mine

(d) All examination reports recorded in accordance with the provisions of paragraph (c) of this section shall include a report of the action taken to abate hazardous conditions and shall be signed or countersigned each day by at least one of the following persons:
(1) The surface mine foreman;
(2) The assistant superintendent of the mine;
(3) The superintendent of the mine;
(4) The person designated by the operator as responsible for health and safety at the mine; or,
(5) An equivalent mine official.

MSHA Training
Explosives & Blasting Safety

Subpart A Part 77
Surface Coal Mines & Surface Work Areas
Of Underground Coal Mine

77.202 Dust accumulations in surface installations

Coal dust in the air of, or in, or on the surfaces of, structures, enclosures, or other facilities shall not be allowed to exist or accumulate in dangerous amounts.

77.204 Openings in surface installations; safeguards

Openings in surface installations through which men or material may fall shall be protected by railings, barriers, covers or other protective devices.

MSHA Training
Explosives & Blasting Safety

Subpart A Part 77
Surface Coal Mines & Surface Work Areas
Of Underground Coal Mine

77.1302 Vehicles used to transport explosives

(a) Vehicles used to transport explosives, other than blasting agents, shall have substantially constructed bodies, no sparking metal exposed in the cargo space, and shall be equipped with suitable sides and tail gates; explosives shall not be piled higher than the side or end.

(b) Vehicles containing explosives or detonators shall be maintained in good condition and shall be operated at a safe speed and in accordance with all safe operating practices.

(c) Vehicles containing explosives or detonators shall be posted with proper warning signs.

MSHA Training
Explosives & Blasting Safety

Subpart A Part 77
Surface Coal Mines & Surface Work Areas
Of Underground Coal Mine

77.1303 Explosives, handling and use

(a) Persons who use or handle explosives or detonators shall be experienced men who understand the hazards involved; trainees shall do such work only under the supervision of and in the immediate presence of experienced men.

(b) Blasting operations shall be under the direct control of authorized persons.

MSHA Training
Explosives & Blasting Safety

Subpart A Part 77
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77.1303 Explosives, handling and use.

(g) Areas in which charged holes are awaiting firing shall be guarded, or barricaded and posted, or flagged against unauthorized entry.
(h) Ample warning shall be given before blasts are fired. All persons shall be cleared and removed from the blasting area unless suitable blasting shelters are provided to protect men endangered by concussion or flyrock from blasting.
(i) Lead wires and blasting lines shall not be strung across power conductors, pipelines, railroad tracks, or within 20 feet of bare powerlines. They shall be protected from sources of static or other electrical contact.
(j) For the protection of underground workers, special precautions shall be taken when blasting in close proximity to underground operations, and no blasting shall be done that would be hazardous to persons working underground.

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77.1000 Highwalls, pits and spoil banks; plans.
Each operator shall establish and follow a ground control plan for the safe control of all highwalls, pits and spoil banks to be developed after June 30, 1971, which shall be consistent with prudent engineering design and will insure safe working conditions. The mining methods employed by the operator shall be selected to insure highwall and spoil bank stability.

77.1003 Benches.
To insure safe operation, the width and height of benches shall be governed by the type of equipment to be used and the operation to be performed.

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77.1006 Highwalls; men working.

(a) Men, other than those necessary to correct unsafe conditions, shall not work near or under dangerous highwalls or banks.

(b) Except as provided in paragraph (c) of this section, men shall not work between equipment and the highwall or spoil bank where the equipment may hinder escape from falls or slides.

(c) Special safety precautions shall be taken when men are required to perform repair work between immobilized equipment and the highwall or spoil bank and such equipment may hinder escape from falls or slides.

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77.1300 Explosives and blasting.

(a) No explosives, blasting agent, detonator, or any other related blasting device or material shall be stored, transported, carried, handled, charged, fired, destroyed, or otherwise used, employed or disposed of by any person at a coal mine except in accordance with the provisions of §§77.1301 through 77.1304, inclusive.

(b) The term "explosives" as used in this Subpart N includes blasting agents. The standards in this Subpart N in which the term "explosives" appears are applicable to blasting agents (as well as to other explosives) unless blasting agents are expressly excluded.

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77.1301 Explosives; magazines.

(a) Detonators and explosives other than blasting agents shall be stored in magazines.

(b) Detonators shall not be stored in the same magazine with explosives.

(c) Magazines other than box type shall be:

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(6) Made of nonsparking materials on the inside, including floors.

(7) Provided with adequate and effectively screened ventilation openings near the floor and ceiling.

(8) Kept locked securely when unattended.

(9) Posted with suitable danger signs so located that a bullet passing through the face of a sign will not strike the magazine.

(10) Used exclusively for storage of explosives or detonators and kept free of all extraneous materials.

(11) Kept clean and dry in the interior, and in good repair.

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(f) Explosives or detonators shall be transported promptly without undue delays in transit.

(g) Explosives or detonators shall be transported at times and over routes that expose a minimum number of persons.

(h) Only the necessary attendants shall ride on or in vehicles containing explosives or detonators.

(i) Vehicles shall be attended, whenever practical and possible, while loaded with explosives or detonators.

(ii)

(j) When vehicles containing explosives or detonators are parked, the brakes shall be set, the motive power shut off, and the vehicles shall be blocked securely against rolling.

(k) Vehicles containing explosives or detonators shall not be taken to a repair garage or shop for any purpose.

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77.1303 Explosives, handling and use.

(h) Ample warning shall be given before blasts are fired. All persons shall be cleared and removed from the blasting area unless suitable blasting shelters are provided to protect men endangered by concussion or flyrock from blasting.

(i) Lead wires and blasting lines shall not be strung across power conductors, pipelines, railroad tracks, or within 20 feet of bare powerlines. They shall be protected from sources of static or other electrical contact.

(j) For the protection of underground workers, special precautions shall be taken when blasting in close proximity to underground operations, and no blasting shall be done that would be hazardous to persons working underground.

(k) Holes shall not be drilled where there is danger of intersecting a charged or misfired hole.

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77.1910 Explosives and blasting; general.

(d) Except as provided in paragraph (c) of this section, all men shall be removed from the slope or shaft prior to blasting.
(e) Blasting areas in slopes or shafts shall be covered with mats or other suitable material when the excavation is too shallow to retain blasted material.
(f) Where it is impracticable to prepare primers in the blasting area, primers may be prepared on the surface and carried into the shaft in specially constructed, insulated, covered containers.
(g) No other development operation shall be conducted in a shaft or at the face of a slope while drill holes are being charged and until after all shots have been fired.
(h) The sides of the slope or shaft between the overhead platform and the bottom where men are working shall be examined after each blast and loose material removed.
(i) Loose rock and other material shall be removed from timbers and platforms after each blast before men are lowered to the shaft bottom.

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77.1700 Communications in work areas

No employee shall be assigned, or allowed, or be required to perform work alone in any area where hazardous conditions exist that would endanger his safety unless he can communicate with others, can be heard, or can be seen.

77.1708 Safety program; instruction of persons employed at the mine

On or before September 30, 1971, each operator of a surface coal mine shall establish and maintain a program of instruction with respect to the safety regulations and procedures to be followed at the mine and shall publish and distribute to each employee, and post in conspicuous places throughout the mine, all such safety regulations and procedures established in accordance with the provisions of this section.

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77.1902 Drilling and mucking operations

Diesel-powered equipment used in the drilling, mucking, or other excavation of any slope or shaft shall be permissible, and such equipment shall be operated in a permissible manner and shall be maintained in a permissible condition.

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77.1710 Protective clothing; requirements

Each employee working in a surface coal mine or in the surface work areas of an underground coal mine shall be required to wear protective clothing and devices as indicated below:

(a) Protective clothing or equipment and face-shields or goggles shall be worn when welding, cutting, or working with molten metal or when other hazards to the eyes exist.

(b) Suitable protective clothing to cover the entire body when handling corrosive or toxic substances or other materials which might cause injury to the skin.

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77.1710 Protective clothing; requirements

(c) Protective gloves when handling materials or performing work which might cause injury to the hands; however, gloves shall not be worn where they would create a greater hazard by becoming entangled in the moving parts of equipment.

(d) A suitable hard hat or hard cap when in or around a mine or plant where falling objects may create a hazard. If a hard hat or hard cap is painted, nonmetallic based paint shall be used.

(e) Suitable protective footwear.

(f) Snug-fitting clothing when working around moving machinery or equipment.

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77.1710 Protective clothing; requirements

(g) Safety belts and lines where there is danger of falling; a second person shall tend the lifeline when bins, tanks, or other dangerous areas are entered.

(h) Lifejackets or belts where there is danger from falling into water.

(i) Seatbelts in a vehicle where there is a danger of overturning and where roll protection is provided.

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Blast Site Safety
Identifying The Hazards

Overhangs
Cavities
Jointing
Mud seams
Falling dirt & debris
Fresh rubble at the toe or pit floor
Formation of cracks
Widening of cracks
Sloping Crest
Back break
Slips & faults
Bedding Planes
Ground water

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Blast Site Safety

What things should we be doing to ensure blast site safety?

- Pre-planning before we even get to the blast site.
- Profiling and boretracking the site.
- Providing safe access to the blast site.
- Inspecting the blast site .
- Identifying hazards and implementing controls.
- Everyone knows their roll and responsibility.
- Everyone trained and in compliance with regulatory.
- Inspect area prior to giving the all clear.

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Blast Site Safety

Not to mention Best Practice

The Blast Site – where are we loading?

The Blast Area – where do we expect rock to land?

The Safety Buffer – where do we not expect rock to land?

The Safety Zone – best place to be!!! That is where you will always find me!

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CRACKS

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OVERHANGS

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BACKBREAK

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Ground Failure Common Causes

Weak joints.
Mud seams.
Blasting effects.
Mucking operations.
Overall slope to steep.
Unstable bench.

Controls
Establish safe distance, for drilling & loading.
Do not position yourself between the highwall & equipment.
Thorough inspection of the highwall.
Consistent examination for new hazards.
Especially, during rain, thaw & freeze.
Scale loose material.
Level & Stable Benches.
Minimize exposure.
Use spotters.

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Methane gas in surface coal mines

In the geological process known as coalification, methane and coal are formed together. Depending upon the geologic conditions, the methane can be trapped within the coal seams and/or the surrounding rock strata. As the coal mining reduces the geologic pressure, the methane is released to the air.

Because methane is explosive in low concentrations, it is hazardous to mines and miners.

Surface Mining. During surface mining, methane is released directly to the atmosphere as the overlying rock strata are removed. No emissions mitigation options are being used at this time. In theory, some pre-mining degasification and recovery could occur at gassy surface mines. However, the low gas content of surface mines relative to that of underground mines makes it unlikely that significant recovery would be technically feasible, let alone cost-effective.

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Purpose of Stemming

Reduce vertical flyrock.
Reduce air blast.
Confine the charge

Best Practice Stemming

Watch boreholes for blocking off hole with big rocks or ice.

Watch for cutting lines with rocks or shovels.

Pull casings from holes carefully as to not allow rocks to fall into borehole, or cut lines.

Wrap lines around rocks to prevent losing them down a hole.

Use clean crushed stone.

Never use hole cuttings.

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- Drill logs are a critical tool in preventing flyrock.
  - Drill log information can assist the blaster in determining if a borehole is cracked or has unconsolidated material in the stemming region

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Fall Prevention vs. Fall Restraint

Know the difference!

Fall Restraint – keeps you from getting to the point where you can fall.

Fall Prevention – keeps you from falling to the Surface if you go over the face.

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Explosive products have the potential to contaminate ground water if it is not Handled properly.

Biggest concern is with nitrates.

How we handle product and housekeeping is critical in order to avoid contamination.

emulsion on the ground.
spilled anfo on the ground.
bulk hose flushed out down a blast hole, or back into the tank, never flush hose onto the ground or over the face.
product from misfires…..all have the potential to contaminate.

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Post blast fumes, no long ago, we did not have a very good understanding.

CO can migrate from shot into nearby buildings.

Factors, geology, bad rock, poor foundations opens in foundation.

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Flyrock Prevention…….best practice

Sources of flyrock……

- Misfires
- Overloaded boreholes
- Inadequate stemming
- Insufficient amount of stemming
- Inadequate face burden
- Excessive face burden
- Inadequate times between rows
- excessive powder factor
- adverse geology

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Good Blast Designs
Good drill reports – with hole depths, amount of overburden, drill abnormalities
Driller reports all abnormalities identified during the drilling process.
Good load practices.
Continual review and communication of blast design.
Work safe, no shortcuts.
Work within regulation.
Report near miss incidents & take action.
Communication
Resources
JHA
Understand geology

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Blasting Mats

Noteworthy Near Miss – Premature Detonation of Explosive Product

During matting operations we had an operator that never set mats.
During the matting operation the operator was moving the mats and happened to catch one of the detonator lines that was attached to the next hole, causing it to break.

During tonight's monthly supervisor meeting it was brought to all of our attention that this action could have resulted in that hole and the rest of the holes in succession to that row to **fire prematurely** resulting in possible injury or death.

Last night's Forman's meeting shed light on the severity of this near miss.

Be safe guys, we're all in this together."

METAL/NONMETAL
Serious Accident

Underground – Sandstone– On March 24, 2018, two miners were using a man-lift to charge (load) blast holes with non-electric blasting caps, 8-grain boosters and ammonium nitrate fuel oil (ANFO) blasting agent. During the loading process, one of the non-electric shock-tubes became wedged on the man-lift basket. As the man-lift operator progressed across the face loading the blast holes, the wedged shock-tube stretched and broke (snapped) causing a pre-detonation of a blast hole. As a result of the pre-detonation, one miner received minor injuries and the other miner serious injuries.

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Best Practices

Explosive materials should be kept organized and under the direct observation of the blaster during loading operations so personnel and equipment does not inadvertently come in contact with them.

The manufacturer's recommendations regarding maximum loading on the tubing are to be followed (e.g. maximum primer weight lowered into hole by the tubing).

Shock tubing is not to be subjected to undue tension by pulling, in hole to hole situations.

Situations in which shock tubing is subjected to impact by falling rock, equipment etc. is to be avoided.

Excess shock tubing can be coiled, but should not be cut off.

Shock l tube downlines should be tied to pegs visible to vehicle operators.

The blast crew should carefully consider the blast design and plan the loading sequence to avoid having to move over or too near to loaded holes.

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Lesson Summary…….surface, surface area, underground, coal, metal/nonmetal

Safety is critical……..have a plan & work your plan.

Understand what you are working with……..remember industry standards Always & Never.

Practice BEST PRACTICE!

Practice good Blast Site Safety